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August 14, 2013

VIA ELECTRONIC FILING
Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

**Re: TransCanada Hydro Northeast Inc.'s Revised Study Plan
Project Nos. 1892-026, 1855-045, and 1904-073**

Dear Secretary Bose:

TransCanada Hydro Northeast Inc. ("TransCanada") is the owner and licensee of the Wilder Hydroelectric Project (FERC No. 1892) (the "Wilder Project"), the Bellows Falls Hydroelectric Project (FERC No. 1855) (the "Bellows Falls Project"), and the Vernon Hydroelectric Project (FERC No. 1904) (the "Vernon Project"). The Wilder Project, the Bellows Falls Project and the Vernon Project are collectively referred to herein as the "TransCanada Projects." The current licenses for these projects each expire on April 30, 2018.

On October 31, 2012, TransCanada filed with the Federal Energy Regulatory Commission (FERC or Commission) its Notice of Intent ("NOI") to seek new licenses for each project, along with a separate Pre-Application Document ("PAD") for each project.

With this filing, TransCanada submits its Revised Study Plan, as required by 18 C.F.R. 5.13(a).

1. BACKGROUND

As described above, TransCanada has filed its NOI and PAD for the TransCanada Projects and is currently engaged in the licensing process for these projects.

FirstLight Hydro Generating Company ("FirstLight") is the licensee of the Turners Falls Hydroelectric Project (FERC No. 1889) (the "Turners Falls Project") and the Northfield Mountain Pumped Storage Project (FERC No. 2485) (the "Northfield Mountain Project").[1] The current licenses for both the Turners Falls Project and the Northfield Mountain Project expire on April 30, 2018. On October 31, 2012, FirstLight filed with the Commission its NOI to seek new licenses for the Turners Fall Project and the Northfield Mountain Project, along with a single PAD for both projects (the "FirstLight PAD").

On December 21, 2012, Commission Staff issued its Scoping Document for its National Environmental Policy Act ("NEPA") analysis of the Connecticut River Projects ("SD1"). Commission Staff indicated in SD1 their intent to prepare a single environmental impact statement ("EIS") for the Connecticut River Projects. In January 2013 in various locations near the projects in New Hampshire, Vermont, and Massachusetts, Commission Staff held six project-specific scoping meetings and one additional scoping meeting to help identify the cumulative effects of licensing the Connecticut River Projects. On April 15, 2013, the FERC issued its Scoping Document 2, in response to verbal and written comments received at the scoping meetings as well as during the scoping process.

TransCanada received comments on the PADs as well as study requests for the TransCanada Projects from state and federal agencies, local officials, non-governmental organizations, and other interested parties (collectively, "stakeholders"). On April 16, 2013, TransCanada filed its Proposed Study Plan pursuant to 18 C.F.R. § 5.11(a).[2] With its filing of the Proposed Study Plan, TransCanada included a study request responsiveness summary, identifying each study request, the study plan responsive to the request, and the rationale for why any particular study request was not adopted. The April 16, 2013, filing also included TransCanada's schedule for study plan meetings. TransCanada recognized that a single meeting would not be adequate to clarify and discuss its Proposed Study Plan. Therefore, it held a series of study plan meetings and discussions regarding its study plan proposals and received extensive feedback and participation from many interested stakeholders within resource-specific working groups. The initial study meeting and subsequent meetings that were held are listed in Table 2 of the Revised Study Plan included with this filing.

Pursuant to 18 C.F.R. § 5.12, comments on the Proposed Study Plan were due on July 15, 2013, i.e., within 90 days of the filing of the Proposed Study Plan. During the consultation process since the filing of its Proposed Study Plan, TransCanada has received, discussed, and reviewed comments on its Proposed Study Plan from stakeholders. In addition, in response to comments received and consultation with stakeholders through the study plan meetings, TransCanada filed with the FERC an updated Proposed Study Plan on July 9, 2013.

[1] The TransCanada Projects, together with the Turners Falls Project and the Northfield Mountain Project, are collectively referred to herein as the "Connecticut River Projects."

[2] Delays caused by FERC's efiling website prevented a filing on April 15, 2013.

2. Revised Study Plan

TransCanada is proposing studies and data collection efforts in its Revised Study Plan to address the effects of continued operation of the TransCanada Projects. TransCanada's Revised Study Plan includes 33 individual studies and data collection efforts. The Revised Study Plan reflects comments received during the study plan meetings and discussions as well as formal comments filed by stakeholders with the FERC. Each of the study plans is described in detail in the Revised Study Plan.

The Revised Study Plan includes a Comments and Response Summary, which includes comments received during the 90-day comment period on the Proposed Study Plan and addresses each of the comments, including a description of the efforts made to resolve differences over study requests. For any requested studies that were not adopted by TransCanada, the Revised Study Plan also includes a discussion of why such requested study was not adopted, with reference to the criteria set forth in 18 C.F.R. § 5.9(b). Specifically, the Revised Study Plan submitted herewith contains the following Appendices:

- Appendix A – Study Requests received by March 1, 2013
- Appendix B – Study Request Responsiveness Summary filed on April 16, 2013
- Appendix C – Consultation Meeting Comments and Response Summary filed on July 9, 2013
- Appendix D – Written Comments and Requests received by July 15, 2013
- Appendix E – Written Comments and Requests Response Summary

If there are any questions regarding the information provided in this filing or the process, please contact John Ragonese at 603-498-2851 or by emailing john_ragonese@transcanada.com.

Sincerely,

John L. Ragonese
FERC License Manager

Attachments: Distribution List
Revised Study Plan

cc: Distribution List

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UNITED STATES OF AMERICA

BEFORE THE

FEDERAL ENERGY REGULATORY COMMISSION

TRANSCANADA HYDRO NORTHEAST INC.

Wilder Hydroelectric Project (FERC Project No. 1892-026)
Bellows Falls Hydroelectric Project (FERC Project No. 1855-045)
Vernon Hydroelectric Project (FERC Project No. 1904-073)

Revised Study Plan

August 14, 2013

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Acronyms and Abbreviations

1-D	one-dimensional
2-D	two-dimensional
3-D	three-dimensional
ADCP	Acoustic Doppler Current Profiler
AMC	Appalachian Mountain Club
APE	Area of Potential Effects
°C	degrees Celsius
C.F.R.	Code of Federal Regulations
cfs	cubic feet per second
cfsm	cubic feet per second per square mile
cm	centimeter
Commission	Federal Energy Regulatory Commission
CPUE	catch-per-unit-of-effort
CRJC	Connecticut River Joint Commissions
CRWC	Connecticut River Watershed Council
DO	dissolved oxygen
DSP	digital spectrum processors
DWM	dwarf wedgemussel
eDNA	environmental DNA
ESRI	Environmental Systems Research Institute
FERC	Federal Energy Regulatory Commission
FEMA	Federal Emergency Management Agency
FWS	U.S. Fish and Wildlife Service
GIS	Geographic Information System
GPS	Global Positioning System
HEC-RAS	Hydrologic Engineering Center–River Analysis System
HP	horsepower
HPMP	Historic Properties Management Plan
HSC	habitat suitability criteria
IFIM	Instream Flow Incremental Methodology
ILP	Integrated Licensing Process
kHz	kilohertz

LiDAR	Light Detection and Ranging
mm	millimeter
MPS	Multiple Property Submission
National Register	National Register of Historic Places
NGO	nongovernmental organization
NHDES	New Hampshire Department of Environmental Services
NHDHR	New Hampshire Division of Historical Resources
NHFG	New Hampshire Fish and Game Department
NHNHB	New Hampshire Natural Heritage Bureau
NHPA	National Historic Preservation Act
NHSHPO	New Hampshire State Historic Preservation Office
NITHPO	Narragansett Indian Tribal Preservation Office
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NTU	nephelometric turbidity unit
PA	Programmatic Agreement
PAD	Preliminary Application Document
PAL	Public Archaeology Laboratory
PHABSIM	Physical Habitat Simulation System
PIT	passive-integrated transponder
PLP	Preliminary Licensing Proposal
PSP	Proposed Study Plan
RHABSIM	Riverine Habitat Simulation
RHY-HABSIM	River Hydraulics and Habitat Simulation Program
RM	river mile
RMP	Recreation Management Plan
rpm	revolutions per minute
RSP	Revised Study Plan
RTK	Real Time Kinematic
SAV	submerged aquatic vegetation
SEFA	System for Environmental Flow Assessment
SGCN	species of greatest conservation need

TCP	traditional cultural property
TNC	The Nature Conservancy
TU	Trout Unlimited, Deerfield River Chapter
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geologic Survey
VANR	Vermont Agency of Natural Resources
VIE	visual implant elastomer tags
Vista DSSTM	Vista Decision Support System
VTSHPO	Vermont State Historical Preservation Office
YOY	young-of-year

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INTRODUCTION

Pursuant to the regulations of the Federal Energy Regulatory Commission (Commission or FERC), 18 Code of Federal Regulations (CFR) Part 5.11, TransCanada Hydro Northeast Inc. (TransCanada) filed its Proposed Study Plan (PSP) for the relicensing of the Wilder Hydroelectric Project (FERC Project No. 1892), Bellows Falls Hydroelectric Project (FERC Project No. 1855), and Vernon Hydroelectric Project (FERC Project No. 1904) on April 16, 2013. The RSP includes studies relevant and necessary to analyze the effects of continued operations of the projects. TransCanada proposed 33 studies and data collection efforts in response to informal comments from stakeholders during scoping meetings in January 2013, and in response to the 32 formal comment and study request letters filed with FERC after the scoping meetings. TransCanada developed a study request responsiveness summary to describe how study requests were incorporated into the 33 studies and to provide Integrated Licensing Process (ILP) study criteria-based rationale for not incorporating some study requests.

Eleven study plan consultation meetings occurred during May, June, and July 2013. The purpose of these meetings was to provide clarification of TransCanada's proposal and receive verbal comments and suggestions from stakeholders. As a result of those meetings, an "Updated PSP" was filed with the FERC on July 9, 2013, and distributed to stakeholder working groups and posted for viewing and download on TransCanada's public relicensing website. The purpose of the updated plan was to provide a basis for written comments from stakeholders that reflected consultation in the study plan meetings. Sixteen additional written letters of comments and/or additional study requests were filed by stakeholders by the July 15, 2013, deadline. Based upon these comments, two additional stakeholder consultations took place on August 6 and August 9, 2013, in which TransCanada sought clarification on specific comments.

This Revised Study Plan (RSP) includes TransCanada's final revisions to study plans as well as responses to study requests, to comments provided in study plan meetings, and to comments and additional requests filed with the FERC by various stakeholders.

STUDY REQUESTS AND RESPONSE

By the March 1, 2013 study request deadline, TransCanada received a total of 245 individual study requests from FERC staff, federal and state resource agencies, municipalities, one regional planning commission, non-governmental organizations, and the public, as listed in Table 1. These requests are included in Appendix A.

Table 1. Stakeholders who filed formal study requests, and stakeholder acronyms used in this RSP.

Request Submittal Authors	**Acronym Used in the RSP**
Appalachian Mountain Club, Vermont River Conservancy, and Friends of the CT River Paddler's Trail	AMC-VRC-FRs
City of Lebanon, New Hampshire Planning Office	Leb
Connecticut River Joint Commissions, Inc.	CRJC
Connecticut River Watershed Council	CRWC
Federal Energy Regulatory Commission	FERC
Lipfert, F. William Jr. and Jennifer Lipfert	Lipfert
Mudge, John B. T.	Mudge
National Park Service	NPS
New England Flow and American Whitewater	NEF-AW
New England Flow, American Whitewater and Appalachian Mountain Club	NEF-AW-AMC
New Hampshire Department of Environmental Services	NHDES
New Hampshire Fish and Game Department	NHFG
New Hampshire Natural Heritage Bureau	NHNHB
The Nature Conservancy	TNC
The Nolumbeka Project, Inc.	Nolumb
Town of Lyme, New Hampshire, City of Lebanon, New Hampshire, and O. Ross McIntyre	Lyme-Leb-McInt
Town of Rockingham, Vermont Conservation Commission	Rock
Trout Unlimited, Deerfield River Chapter	TU
Trustees of Pine Park Association, Hanover New Hampshire	Han
Two Rivers-Ottauquechee Regional Commission	TwoRiv
US Fish and Wildlife Service	FWS
Vermont Agency of Natural Resources	VANR
Vermont State Historical Preservation Office	VT SHPO

Additional comments without formal study requests were received from 21 commenters representing a state agency, municipalities, non-governmental organizations, a power producer, local conservation commissions, a heritage commission, a university, a farmers union, and residents.

Some study requests did not meet one or more of the seven ILP study request criteria (18 C.F.R. § 5.9(b)) in substantive ways and have been excluded from the RSP on that basis. Where reasonable and of nominal additional cost to the study, however, some of those study requests that did not meet one or more the seven ILP criteria have been incorporated into study plans developed from other requests that did fulfill the ILP study criteria. Responses to each of the 245 initial study requests were provided in the Study Request Responsiveness Summary, filed on April 16, 2013 (see Appendix B). That summary has been supplemented based upon the consultation meetings with stakeholders during May and June and written comments filed with the FERC by July 15, 2013, as described in the following section.

Study requests that TransCanada felt did not warrant a study plan (referred to as excluded studies) were identified in the April 16 Responsiveness Summary, discussed at the initial study plan meeting on May 13, 2013, and discussed further during the stakeholder conference call on June 18, 2013. All of the particular study requests identified as excluded studies continue to remain outside of this RSP.

STUDY PLAN COMMENTS AND RESPONSE

As required under the Commission's regulations, 18 C.F.R. § 5.11(e), TransCanada held an initial consultation meeting to discuss the PSP on May 13, 2013, in West Lebanon, New Hampshire. The purpose of that meeting was to clarify and discuss the PSP with Commission staff and stakeholders (specifically the study requestors); identify study plan interest working group participants; describe immediate data collection initiatives; and review the subsequent meeting schedule.

TransCanada convened various resource working groups at subsequent meetings (see Table 2) to engage with Commission staff and stakeholders in ongoing consultation prior to the stakeholder PSP comment deadline on July 15, 2013. The meetings provided a forum to work toward consensus on this RSP. Subsequent meetings were held in White River Junction, Vermont, with some participants present and others calling in on a web-enabled conference line. Each proposed study plan was reviewed in detail in these meetings. Comments were expressed, discussed, and documented with the intent of addressing concerns and agreeing to revisions prior to the stakeholder comment deadline of July 15. A summary of the meeting discussions and comments, together with the actions proposed or under consideration by TransCanada, was filed with the Commission and distributed to stakeholders and the public as an Updated Proposed Study Plan on July 9, 2013 (see Appendix C).

Table 2. Study plan meetings.

Resource Area	Date	Location
Study Plan Overview and Excluded Studies	May 13, 2013	West Lebanon, NH
Erosion, Geology and Soils	May 16, 2013	White River Junction, VT and conference call meeting
	June 20, 2013	Conference call meeting
Water Resources and Modeling	May 16, 2013	White River Junction, VT, and conference call meeting
	June 20, 2013	Conference call meeting
Aquatics	May 20, 2013	White River Junction, VT, and conference call meeting
	May 23, 2013	White River Junction, VT, and conference call meeting
	June 6, 2013	White River Junction, VT, and conference call meeting
	June 21, 2013	Conference call meeting
	August 9, 2013	Conference call meeting – Study Plan 12 clarifications
Terrestrial	June 6, 2013	White River Junction, VT, and conference call meeting
	June 7, 2013	White River Junction, VT, and conference call meeting
	June 20, 2013	White River Junction, VT, and conference call meeting
Recreation and Aesthetics	June 7, 2013	White River Junction, VT, and conference call-in
	June 20, 2013	Conference call meeting
Cultural and Historic Resources	June 7, 2013	White River Junction, VT, and conference call-in
	June 19, 2013	Consultation meeting with Narragansett Tribe
	July 2, 2013	Conference call meeting
	August 6, 3013	Conference call meeting with Vermont and New Hampshire State Historic Preservation Officers seeking comment clarification
Excluded Study Requests	June 18, 2013	Conference call meeting

Notes from the formal May 13, 2013 study plan meeting were distributed to all attendees and the FERC on May 28, 2013, and posted to TransCanada's public relicensing website. All subsequent consultation meeting notes were reviewed verbally prior to the meeting conclusion and compiled with proposed actions to be undertaken by TransCanada (i.e., under review, acceptable, revisions to be made) and presented to all working group members prior to the study plan revision discussion meetings on June 1 and 2, 2013. A copy of the meeting notes from May 13, 2013 and comments from the working group meetings were included in the Updated PSP filed with the FERC on July 9, 2013.

The RSP reflects the informal and formal stakeholder comments and discussion that occurred during the 3-month study plan comment period from April 15 through July 15, 2013. Formal comments on the PSP were filed with the FERC by the following parties (see Appendix D):

- American Whitewater
- Appalachian Mountain Club, Vermont River Conservancy, and Friends of the Connecticut River Paddler's Trail
- City of Lebanon New Hampshire
- Connecticut River Joint Commissions
- Connecticut River Watershed Council
- F. William, Jr. and Jennifer Lipfert
- Narragansett Indian Tribal Historic Preservation Office
- National Park Service
- New England Flow
- New Hampshire Department of Environmental Services
- New Hampshire Fish and Game Department
- The Nature Conservancy
- The Nolumbeka Project
- U.S. Fish and Wildlife Service
- Vermont Agency of Natural Resources
- Vermont Division for Historic Preservation

A summary of all written comments and TransCanada's responses are included in Appendix E.

STUDY PLAN PROPOSAL

This RSP includes 33 study plans, most of which incorporate multiple study requests and encompass all three projects. Study plans that are specific to a project are so noted. The list of study plans, estimated costs, and general study implementation schedule are included in Table 2. Stakeholder consultation meetings, discussions, and comment letters received during the 3-month comment period led to agreed-upon plan revisions. As a result, study implementation costs have increased over the original PSP's estimated costs by $1.3 million or 26 percent to a total estimated study cost range of $6 million to nearly $6.4 million.

Immediate Study Plan Data Needs

The ILP study schedule for this relicensing dictates that a study year will be from October through September. The seasonality of field investigation for different target species being studied also varies. Further, many studies are interrelated, with data from some studies required for the analysis of others. In many cases, field work in study year 1 will be followed by analysis of project effects at the start of year 2 and reported on prior to the field session in year 2.

TransCanada is initiating specific data collection efforts identified in Table 2 under "Preliminary Data Collection Initiatives." Those efforts will facilitate other studies that will rely on collecting baseline data starting in summer 2013. TransCanada explained the reasons for initiating this effort at its May 13, 2013, meeting, and obtained stakeholder and FERC concurrence for its initiative. Preliminary data collection initiatives, updated as of this filing, include:

- Completed: Obtain Light Detection and Ranging or Laser Imaging Detection and Ranging (LiDAR) and Digital Photogrammetry of up to 185 miles of the Connecticut River, which would encompass all potential project-affected areas. Data from this will help to provide a current picture of the river corridor with immense detail and accuracy to support model refinement and numerous studies.

- In progress: Obtain side-scan sonar data and bathymetry data in all accessible areas within the impoundments. Data will support habitat mapping, HEC-RAS model refinement, and numerous aquatic studies. Substrate and littoral zone analysis may also be conducted. Data and mapping would serve as the basis for selecting study sites and establishing transect locations for all other aquatic habitat studies. This information will provide hydrographic and topographic cross sections and reservoir operational characteristics that can be used for model refinements and hydraulic modeling, and will support erosion studies.

- In progress: Installation of pressure transducers for depth monitoring in a variety of locations both upstream and downstream of the dams. Data will support calibration of the hydraulic model, habitat index curves, reservoir operational characteristics, and also will provide a monitoring record.

- In progress: Erosion monitoring initial site identification and full river transect surveys.

TransCanada is also considering early implementation of the following studies:

- Dwarf Wedgemussel and Co-Occurring Mussel Study, Phase 1, initial survey. This information is needed early to identify sites where dwarf wedgemussel densities are high enough to permit quantitative sampling, behavioral studies, or habitat studies for the study's Phase 2 survey in 2014. Early concurrence by resource agencies is needed to develop the timeline and plan for Phase 2.

- Cultural and Historic Resources Study (Study 33) is proposed to be implemented in 2013 because some of the requested work was completed prior to the related study requests. The draft Phase IA archaeological reconnaissance reports for Wilder and Bellows Falls were submitted to the Vermont and New Hampshire State Historic Preservation Offices and Tribes on May 29, 2013, and filed with the FERC on July 1, 2013. The Vernon Project archaeological monitoring program under its current Historic Resources Management Plan is scheduled to be conducted in 2013 with the report to be submitted before December 31, 2013.

Study Implementation Schedule

Outside of the preliminary data collection and study initiatives described above, most studies are planned for implementation during one or two study years (see Table 2), following FERC's study plan approval. This schedule assumes that no Notices of Formal Study Disputes are filed by mandatory conditioning agencies during the 20-day period after FERC's study plan determination, expected on September 13, 2013.

Study progress reports will be submitted at important study milestones and will summarize, for each study:

- pre-field season activities completed or in progress;

- field season activities; and

- post-field season activities completed.

In keeping with the ILP study schedule, interim study reports for studies extending beyond 1 year will be submitted within 1 year of FERC's study plan approval, with final reports for all studies submitted within 2 years of FERC's study plan approval.

Table 2. Summary of ILP study plans, costs, and implementation schedule.

Study No.	Study Title	Preliminary Estimated Cost ($s)	Preliminary Data Collection Initiatives (2013)	Study Year 1[a]	Study Year 2 (including data analysis and reports for year 1 studies)
1	Historical Riverbank Position and Erosion Study	55,000		x	x
2	Riverbank Transect Study	245,000	x	x	x
3	Riverbank Erosion Study	460,000		x	x
4	Hydraulic Modeling Study	170.000	x	x	x
5	Operations Modeling Study	240,000	x	x	x
6	Water Quality Study	280,000		x	x
7	Aquatic Habitat Mapping Study	290,000	x	x	
8	Channel Morphology and Benthic Habitat Study	175,000		x	x
9	Instream Flow Study	350,000–500,000		x	x
10	Fish Assemblage Study	230,000	x	x	
11	American Eel Survey	115,000		x	x
12	Tessellated Darter Survey	85,000		x	x
13	Tributary and Backwater Fish Access and Habitats Study	70,000		x	x
14	Resident Fish Spawning in Impoundments Study	80,000		x	x

Study No.	Study Title	Preliminary Estimated Cost ($s)	Preliminary Data Collection Initiatives (2013)	Study Year 1[a]	Study Year 2 (including data analysis and reports for year 1 studies)
15	Resident Fish Spawning in Riverine Sections Study	60,000		x	x
16	Sea Lamprey Spawning Assessment	150,000		x	
17	Upstream Passage of Riverine Fish Species Assessment	138,000		x	x
18	American Eel Upstream Passage Assessment	240,000		x	x
19	American Eel Downstream Passage Assessment	400,000–450,000		x	x
20	American Eel Downstream Migration Timing Assessment	30,000		x	
21	American Shad Telemetry Study - Vernon	265,000	x	x	
22	Downstream Migration of Juvenile American Shad - Vernon	360,000–420,000		x	x
23	Fish Impingement, Entrainment, and Survival Study	65,000			x
24	Dwarf Wedgemussel and Co-occurring Mussel Study	80,000–130,000	x	x	x
25	Dragonfly and Damselfly Inventory and Assessment	101,000	x	x	x
26	Cobblestone and Puritan Tiger Beetle Survey	48,000		x	x

Study No.	Study Title	Preliminary Estimated Cost ($s)	Preliminary Data Collection Initiatives (2013)	Study Year 1[a]	Study Year 2 (including data analysis and reports for year 1 studies)
27	Floodplain, Wetland, Riparian, and Littoral Vegetation Habitats Study	211,000	x	x	x
28	Fowler's Toad Survey	56,000		x	x
29	Northeastern Bulrush Survey	23,000		x	x
30	Recreation Facility Inventory and Use & Needs Assessment	390,000		x	x
31	Whitewater Boating Flow Assessment - Bellows and Sumner Falls	90,000		x	x
32	Bellows Falls Aesthetic Flow Study	40,000		x	
33	Cultural and Historic Resources Study	422,000–457,000	x	x	
TOTAL ESTIMATED STUDY COST:		**$6,014,000–$6,359,000**			

[a] Study year 1 will begin after October 3, 2013 (20 days after FERC's study plan determination expected on September 13, 2013), unless specific studies are the subject of dispute by mandatory conditioning agencies. In those cases, study year 1 will begin on December 12, 2013, upon FERC's study dispute determination (see 18 C.F.R. §s 5.13(d) and 5.14).

TRANSCANADA/FIRSTLIGHT PROJECT-AFFECTED AREA

A number of study requests proposed study areas for TransCanada studies that are outside the appropriate geographic study area. In general, the revised study plans define the geographic study area as those lands within the project boundaries and the lands and waters affected by project operations in the riverine sections below Wilder dam and Bellows Falls dam and a limited area below Vernon dam. The section below Vernon dam has been identified as a study reach for particular study requests. Specific to the reach below Vernon dam, TransCanada has made significant changes to a number of proposed study plans.

In a post-PAD issued report, FirstLight contends that the reach immediately below Vernon is not affected by the operation of FirstLight's Turners Falls Project. TransCanada strongly disputes this and has clear evidence from its tailwater elevation data at the base of Vernon dam that, under Vernon minimum flow periods, the tailrace elevation commonly ranges 4 feet between 181 and 185 feet in elevation above mean sea level. That bandwidth continues to be present throughout the operating range of Vernon Station. TransCanada also acknowledges that, based upon the same tailwater elevation data, the overall operating range of Vernon's 10 generating units can also affect the tailwater by approximately 5 feet, independent of the effect from downstream projects.

The relevant question remains: How far downstream, and to what extent is Vernon's 5-foot effect felt versus how far upstream does FirstLight's 4-foot effect (measured at the base of Vernon dam) becomes the more dominant element affecting the reach below Vernon dam?

TransCanada identifies the Vernon Project Boundary as the downstream side of Vernon dam and encompasses the project lands surrounding the site of the facility (upstream and downstream of the dam); FirstLight presently denotes the upper boundary of the Turners Falls Project as the base of Vernon dam. TransCanada's RSP includes an examination and assessment of Vernon Project operational effects on resources and habitat to a point just below Stebbins Island, approximately 1.5 miles downstream of Vernon dam. Evaluation of Vernon Project effects in this section below Vernon dam has been included in all appropriate revised study plans. However, TransCanada also suggests that these evaluations will include an examination of the extent to which Vernon's discharge as a significant and material influencing factor above those associated with the FirstLight projects when considering frequency, duration, and periodicity of such factors and conditions.

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REVISED STUDY 1

HISTORICAL RIVERBANK POSITION AND EROSION STUDY

RELEVANT STUDY REQUESTS

FERC-03

STUDY GOALS AND OBJECTIVES

The goal of this study is to assess the historical erosion and river bank movement within the Wilder, Bellows Falls, and Vernon Project boundaries to consider the effect and contribution of project operations on erosion in a reasoned way. FERC contends that although erosion, in and of itself, is not necessarily an adverse effect, areas of excessive erosion that are a direct result of project operations or that may be having an adverse effect on another resource are of concern. Potential resources that may be affected are aquatic, terrestrial, cultural, recreation, or socioeconomic.

Documentation of historical riverbank information, surveys, and photographs would provide an opportunity to quantify or compare changes over an extended period and provide a relative scale and potential quantification of erosion among various locations over time within each project along the Connecticut River. The results of this study alone will not enable a determination of the effects of project operations on erosion, but, together with other related studies, will facilitate conclusions as to the association and effect of project operations on active erosion at various locations within or areas affected by the three projects.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

No relevant resource management goals of agencies or Indian tribes with jurisdiction over the subject resources directly apply to this study.

ASSOCIATION WITH OTHER STUDIES

The results of this study, together with other studies, will facilitate assessments of the association and effect of project operations on active erosion at various locations. These studies include:

- Riverbank Transect Study (Study 2) — Transects will be selected for more detailed monitoring and determination of project operations relative to conditions at specific erosion sites of interest.

- Riverbank Erosion Study (Study 3) — Results will characterize the processes of erosion that occur and attempt to ascertain the causes of erosion and the effects of erosion on other resources.

- Hydraulic Modeling (Study 4) and Operations Modeling (Study 5) — Modeling will provide water level, flow, and velocity information over time.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Several studies of riverbank erosion have been conducted, but they have mostly addressed specific erosion sites along the shoreline and did not include comparative mapping efforts to determine where the river channel has moved or by how much. Previous studies also did not estimate areas of land lost or gained as a result of those movements.

The study prepared for the U.S. Army Corps of Engineers (USACE) in 1979 (Simons et al., 1979) was one of the first comprehensive studies along the Connecticut River to assess the causes of river shoreline erosion. The study mainly provided a discussion of the various types of erosion occurring along the river at that time and identified specific erosion locations and various causes of erosion. The 2010 erosion study conducted by Kleinschmidt Associates, Inc. (Kleinschmidt, 2011) for TransCanada in the Wilder, Bellows Falls, and Vernon Project areas identified areas along the shoreline where erosion was classified as stable or active and provided mapping of these areas. However, that report provides a snapshot of relatively recent conditions but no perspective relative to changes in erosion sites over time. The mapping data that were obtained for that study may be used in this study.

Archival mapping and information are needed to identify where erosion occurred and to characterize the degree of erosion that has occurred over time.

PROJECT NEXUS

Erosion is likely to occur whenever moving water intersects with land. It is a natural process with both beneficial and adverse potential effects. The PADs describe a daily run-of-river/peaking mode of operation that results in impoundment and tailwater flow fluctuations, which, in turn, result in fluctuations of water levels. As referenced in the PADs, Simons et al. (1979) identifies water fluctuations as a factor in erosion. Areas of excessive erosion that are a direct result of project operations or that may be having an adverse effect on another resource are of concern. The potential resources that may be affected are aquatic, terrestrial, cultural, recreation, and socioeconomic.

This study aims to identify riverbank erosion conditions observed over a longer period, allowing a comparison of historical and current conditions. Coupled with information from related studies (2, 3, 4, and 5), these data could help provide a better understanding of potential project effects on erosion.

STUDY AREA AND STUDY SITES

The study area includes the shoreline of the Wilder, Bellows Falls, and Vernon impoundments, as well as the shoreline of the riverine reaches downstream of the Wilder and Bellows Falls dams, and is limited to approximately 1.5 miles downstream of Vernon dam to the lower extent of Stebbins Island.

METHODS

The methods used for this study do not precisely follow those requested by FERC. The methods requested would require significantly more effort, specifically as related to conducting literature and document search at local towns and Registry of Deeds for historical information, land purchases, easements, land surveys, and real estate data. TransCanada's estimation is that significant effort and cost would be required to acquire what is likely to amount to little to no relevant data and information. All acquired information would require extensive analysis, manipulation, and processing to enable even the most modest comparisons to existing aerial photogrammetry and mapping. Therefore, this study will use the following methods:

- Conducting a document search within TransCanada's own records to identify historical information on project maps locating the edge of river and erosion monitoring.
- Researching available Federal Emergency Management Agency (FEMA) flood insurance studies where field surveys may have been conducted at key locations along the impoundments.
- Researching available aerial photographic records, such as those available from the National Agriculture Imagery Program and Natural Resources Conservation Service (NRCS).
- Digitizing the river's edge, islands, and bars from various historical references and attempting to overlay them for comparison. Lacking consistent reference points and control, overlaying these layers may require various map fitting functions to enable them to match up as best as possible. These efforts may introduce potential misrepresentations of the historical river's edge, preventing calculation of total bank loss in any location. However, depending upon the age of the source data, it should be possible to identify significant areas of bank loss, channel migration, and the associated historical periods over which it has occurred.

Within reason, additional sources of valid (i.e., licensed survey) information on river bank changes will be sought by: 1) contacting riverfront landowners and municipalities to request maps and other relevant information; 2) speaking with NRCS personnel who have received requests for assistance from riverfront landowners; 3) conducting archival searches at state and local historical societies in instances where other data are not available; and 4) consulting with the erosion working group to explore further potential resources. These additional focused efforts will be restricted to areas for which significant bank erosion and other channel changes are known to have occurred and further refinement on the timing and magnitude of the changes is warranted.

ANALYSIS

The information acquired will be used to qualify and attempt to quantify historical bank movement, bar growth or loss, and erosion. Results from related studies (2, 3, 4, and 5) will also inform the analysis and conclusions of this study. The mapping and information gathered will be overlain and compared to identify locations where the river channel and bars have moved over time. Where possible, efforts will be made to estimate the quantity of land lost or gained. Such estimates will depend on the variability, comparable accuracy, and degree of consistent horizontal control among the various sources to allow for comparable layering without significant adjustment.

At a minimum, it is expected that given reasonable, well-depicted shorelines, significant areas of bank loss from erosion and channel migration will be detectable. Correlating bank loss to a specific period or time frame, historical hydrologic events, or other causal agents depends upon the accuracy and periodicity of the source information. The analysis of potential causal agents will include an investigation of whether flood frequency, project operations, tributary inputs, or other conditions (e.g., bank armoring) have changed during periods and at locations where significant erosion has been identified. Correlations between erosion and other changes along the river could potentially identify the causes for erosion; however, no historical changes in operations have occurred since minimum flows were established in mid-1970s.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

This study involves gathering various forms of historical information including property maps, aerial photographs, and other maps and information that can be compared to assess river channel movement and erosion over time. This is a generally accepted document research methodology. Established Geographic Information System (GIS) standards for geo-rectification will be used to compare the various aerial photographs and maps with an investigation to be undertaken at the outset of the study to ensure recent advances are incorporated.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. The report will summarize the data gathered and analyzed and present written and visual comparisons of data gathered from different periods. All sources of information will be documented. Information will be presented in a GIS format to ensure the results can be readily shared. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the Preliminary Licensing Proposal (PLP) or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This is a 1-year study. All research related to this study and the analysis will be completed during the first study year (2014).

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this study is $55,000.

REFERENCES

Kleinschmidt (Kleinschmidt Associates, Inc.). 2011. Lower Connecticut River Shoreline Survey Report—2010: Bellows Falls Project (FERC No. 1855), Wilder Project (FERC No. 1892), Vernon Project (FERC No. 1904). Prepared for TransCanada Hydro Northeast Inc., Westborough, MA. March 2011.

Simons, D.B., Andrews, J.W., Li, R.M., and M.A. Alawady. 1979. Connecticut River Streambank Erosion Study—Massachusetts, New Hampshire, and Vermont. Prepared for the U.S. Army Corps of Engineers, New England Division.

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REVISED STUDY 2

RIVERBANK TRANSECT STUDY

RELEVANT STUDY REQUESTS

FERC-02,-04; NHDES-21a, -21b, -21c; NHFG-21a, -21b, -21c; VANR-01; CRWC-01, -02, -03; Han-01; Lipfert-01; Lyme-Leb-McInt-01; Mudge-01; TwoRiv-03

STUDY GOALS AND OBJECTIVES

In their study requests, FERC, NHDES, NHFG, VANR, CRWC, and others have identified water-level fluctuations and flow peaking related to Wilder, Bellows Falls, and Vernon Project operations as a potential contributing factor to bank erosion and soil loss in project-affected areas. In response to that request, the goal of this study is to monitor riverbank erosion at selected sites in the impoundments and project-affected riverine sections below Wilder and Bellows Falls dams.

The erosion monitoring will include repeated cross sections, ground photographs, and water-level monitoring at 20 sites (10 associated with Wilder dam, 6 with Bellows Falls, and 4 with Vernon). Relationships observed between changing water levels and the timing of bank erosion will help establish whether water-level fluctuations, described in terms of magnitude, periodicity and duration, and increased shear stresses resulting from project operations are correlated with erosion in project-affected areas. Observed water-level fluctuations and shear stresses from nonproject-related factors will also be investigated.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

NHDES	• State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	• General goals related to healthy ecosystems to support fish and wildlife. Goals reference the NHFG Strategic Plan 1998–2010 (NHFG, 1998).
VANR	• State water quality standards for designated uses of Class B waters relative to flow alteration, water-level fluctuations and anti-degradation provisions. The Connecticut River below Wilder dam is listed as impaired waters on the Section 303(d) due to flow alterations.

ASSOCIATION WITH OTHER STUDIES

A number of other studies should be completed in conjunction with this study. The initial surveys of full river transects in this study will provide topographic cross sections that can be used in Hydrologic Engineering Center–River Analysis System (HEC-RAS) modeling to be conducted as part of the Hydraulic Modeling Study (Study 4). In turn, the modeling results from Study 4 will be useful in determining shear stresses acting on the monitored banks during different flow conditions. Water-level monitoring as part of this study could prove useful in calibrating hydraulic modeling efforts used in Study 4. Depending on the location of the monitoring sites, this study may also prove useful for the Channel Morphology and Benthic Habitat Study (Study 8) and other studies focused on habitat and recreational issues that erosion might affect.

The results of this study will also be used to help interpret longer-term bank movement that will be assessed in the Historical Riverbank Position and Erosion Study (Study 1). An investigation of the processes and causes of erosion in the Riverbank Erosion Study (Study 3) will rely heavily on the results of this study and will be helpful in selecting sites that represent a range of conditions, some having experienced significant channel migration and others exhibiting long-term bank stability.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Background information about project operations, river and watershed characteristics, and previous studies completed in the area were detailed in the PADs. Erosion in the project-affected areas was previously mapped by Simons et al. (1979) and Kleinschmidt (2011). Bank height, bank slope, land use, and land cover were identified at each erosion site in Kleinschmidt (2011); however, no assessment was made of the trends or rates of erosion at each project.

Surficial geology maps prepared on U.S. Geological Survey (USGS) 7.5-minute topographic quadrangles published by the New Hampshire Geological Survey are, or soon will be, available for most of the study area. NRCS soils maps have also been developed and are available for most of the project areas. A thorough review of these maps will be important for ensuring the selected monitoring sites encompass a range of soil types and geomorphic settings.

Glacial Lake Hitchcock occupied most of the Connecticut River Valley in the project areas at the end of the last ice age, depositing thick sequences of varved lacustrine clays and other fine sediments. Geologists have investigated these sediments for many years (Ridge and Larsen, 1990), and a review of this literature as part of the Riverbank Erosion Study (Study 3) will provide additional information on the location, thickness, and stratigraphy of such deposits. These studies will be used to better understand conditions at monitoring sites where varved clays are present.

PROJECT NEXUS

Study requesters consider water-level fluctuations and peaking flows downstream of dams as potential causes of erosion. Simons et al. (1979) attributes water fluctuations, both natural and those associated with dam operations, to be a factor in erosion in the project-affected areas. This study will ascertain the relative importance of water-level fluctuations associated with project operations in the erosion process relative to other contributing factors and how the importance of water-level fluctuations in the erosion process varies with soil type and geomorphic setting. Water-level fluctuations, particularly those associated with the projects, represent only one process increasing the potential for bank instability with the cumulative effect of multiple processes that either increase the driving forces of instability (e.g., high shear stress and water seepage) or decrease the resisting forces (e.g., loss of bank vegetation and loss of soil cohesion), ultimately, leading to erosion.

Comparing the site-specific conditions at each transect study site with rates of erosion will provide key input in determining whether routine project operations, high flood flows, or a combination of factors is causing bank erosion.

STUDY AREA AND STUDY SITES

The study will be conducted at 20 bank transects (10 associated with Wilder, 6 with Bellows Falls, and 4 with Vernon). FERC requested 30 transects (10 for each project); the 10 proposed for Wilder are appropriate given the impoundment length and the higher rate of erosion compared to the other projects (Kleinschmidt, 2011), and the erosion concerns expressed by numerous study requesters. However, fewer sites are recommended at the other projects because of shorter impoundment length and lower rates of erosion. The 20 total transects will still enable a comparison of conditions at sites both upstream and downstream of each project, representing a range of soil types and bank characteristics. The exact location of the transect sites will be based on a review of previous erosion studies (e.g., Simons et al., 1979; Kleinschmidt, 2011), analysis of soils and surficial geology maps, initial field reconnaissance, inspection of historical aerial photographs, and examination of project operations data to ensure the sites encompass a range of soil types, stratigraphic conditions, vegetation densities, erosion types, bank slopes (and other morphological characteristics), water-level fluctuations, and peaking flow conditions.

Once an initial list of potential transect sites is developed based on these criteria, an effort will be made to select sites that address site-specific concerns raised in study requests associated with the New Hampshire bank near Wilder dam, such as at River Road in Lyme just south of the North Thetford Road; River Road a quarter mile south of the East Thetford Bridge, the Mudge and McIntyre properties in Lyme, Pine Park in Hanover, and the Lipfert property in Cornish. The final selection of monitoring sites will be done in conjunction with the erosion working group to ensure stakeholder input and will be completed by October 15, 2013.

The study area includes the shoreline of the Wilder, Bellows Falls, and Vernon impoundments, as well as the shoreline of the riverine reaches downstream of the Wilder and Bellows Falls dams, and is limited to approximately 1.5 miles downstream of Vernon dam to the lower extent of Stebbins Island.

METHODS

The following methodology will be used with tasks completed in the listed order, if possible:

Site Selection

The 20 transect sites will be selected so a range of soil types, stratigraphic conditions, vegetation densities, erosion types, bank slopes (and other morphological characteristics), water-level fluctuations, and peaking flow conditions are incorporated into the analysis. Site selection will be based on a review of previous erosion studies (e.g., Simons et al., 1979; Kleinschmidt, 2011), analysis of soils and surficial geology maps, initial field reconnaissance, inspection of historical aerial photographs, and examination of project operations data. The 20 sites will be selected from a larger initial list that will detail information on location (detailed with a map and GPS coordinates), setting (e.g., bank height and composition), and landownership. The final monitoring sites will be selected in collaboration with the erosion working group for input on the number, location, and distribution of sites upstream and downstream of each dam.

Establishing Monitoring Sites

The initial monitoring of the sites will include establishing full river cross sections using standard topographic and bathymetric survey methods. The surveys will be completed using a Sokkia Set 5 electronic total station and referenced to a project datum, both vertically and horizontally. Bathymetric information along the transects will be collected using a hand-held depth sounder with an accuracy of 0.1 foot, but more comprehensive bathymetric information will be collected throughout project-affected areas as part of the Aquatic Habitat Mapping Study (Study 7). Permanent, recoverable control points at the site will also be established with benchmarks and Global Positioning System (GPS) coordinates (and will remain in place following completion of the 2-year monitoring study). Subsequent monitoring of the cross sections will include only one bank of the river and will extend from a point 50 feet upland from the top of bank to a wadeable depth into the water with data to be collected at a sufficient density to accurately describe the slope geometry and discern erosion amounts of 0.1 foot or less over all or even a small portion of the bank height. Survey points will be taken at every marked change in bank slope with at least 10 survey points measured from the top to bottom of the bank. In addition to establishing the survey transects, the initial site monitoring will also characterize site and bank conditions with information to be collected on bank stratigraphy, soil type and horizons, bank stability, vegetation, water seeps, channel features (e.g., mid-channel bars), and valley features (e.g., downstream constrictions). Multiple, oriented ground photograph stations will also be established at each site to capture changes in bank conditions through time; the ground photographs will be retaken at the same locations, as recorded with GPS coordinates, during each subsequent visit to the sites. GIS shapefiles will be established for each monitoring site showing the location of the cross sections and ground photograph stations, and attribute tables will be prepared to provide information on landowners, bank composition, and other relevant information.

Repeat Surveys

As requested by FERC, surveys at the 20 sites will be resurveyed and ground photographs retaken at least four times per year for 2 years. The surveys will occur immediately after high spring flows, early and late summer, and then in late fall with additional surveys conducted within 15 days of any significant high-water event (monitoring trigger flow to be determined after review of exceedance curves of natural inflows). Evidence for ice-related conditions will be recorded during the survey immediately following high, spring flows. While NHDES, NHFG, and VANR have also requested monitoring of several bank transects on a biweekly basis for 1 year at 18 monitoring sites (three in each project impoundment and three downstream of each dam), this additional monitoring is not incorporated into this study because the erosion rates have not been determined and to initiate the monitoring frequency biweekly is extremely excessive, costly and without merit. The significant added cost is not warranted given the limited additional benefit to be gained from the more intensive monitoring, unless significant bank erosion is documented during initial monitoring.

TransCanada will consult with the erosion working group during the 2-year monitoring period to discuss the need for, and locations of, increased sampling frequency based on the initial monitoring results and any information gleaned from the historical data research in Study 1 (Historical Riverbank Position and Erosion) that supports the need for more periodic monitoring based on significant erosion rates. The need for, and extent of, additional monitoring approaches (e.g., groundwater-level monitoring) could also be discussed in consultation.

Surface Water Level Monitoring

To monitor surface water levels, pressure transducers will be submerged in stilling wells placed in the river at the 20 monitoring sites. The transducers will be set to automatically record water levels at 15-minute intervals and will be able to measure changes in water levels with an accuracy of 0.02 foot. To calibrate the submerged transducers, up to six additional transducers will need to be deployed to record changes in air pressure. These additional transducers will be placed at or near monitoring sites, but they may not be needed at all sites because air pressure does not generally vary significantly over short distances with minimal elevation variations. Data will be retrieved from the transducers each time surveying is scheduled at the monitoring sites. The pressure transducers will be removed during the first winter to prevent breakage, but the stilling wells will remain in place to ease redeployment of the transducers in the second year. If most of the stilling wells are not damaged by icing during the first winter, six transducers will remain in place during the second winter (one upstream and one downstream of each project).

Flow records at the dams in conjunction with hydraulic modeling will be used to provide information on fluctuations in water levels at the monitoring sites where water-level monitors are removed for the winter. The modeling will develop stage-flow relationships that are equally applicable throughout the year, and the hydraulic modeling and operations modeling will describe how water levels fluctuate throughout the reservoirs and downstream reaches at erosion sites and other resource areas.

The bank monitoring techniques described above were selected to match as closely as possible those requested by FERC with water-level monitoring added so correlations can be identified, if present, between erosion and high-water events or frequent water fluctuations caused by project operations or other factors.

ANALYSIS

The data collected as part of this study will be analyzed to assess whether the timing of documented bank erosion is associated with flood events, project operational water-level fluctuations, or other factors. The repeated topographic surveys and ground photographs will document the location, amount, and timing of erosion for a 2-year period. Site characteristics and recorded water levels will be compared with the erosion monitoring data to assess whether high rates of erosion are associated with certain soil types, bank heterogeneities (e.g., sand-clay interfaces), bank seeps, or water-level fluctuations. Graphs, tables, and matched photographs will be developed to highlight comparisons between different data sets, and all data will be incorporated into a GIS database to ease comparisons between sites and sharing of information with interested stakeholders.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The various methods to be used for this study conform to generally accepted scientific practice. Topographic surveys and repeat ground photography are standard methods that have been used in geomorphic monitoring studies for decades (Lawler, 1993). A further evaluation of monitoring approaches will be conducted when the study is initiated to ensure all of the work is conducted using established monitoring standards.

DELIVERABLES

A report will be prepared that presents methods, analysis and results of the study. The report will include GIS shapefiles of monitored sites, topographic cross sections showing changes through time, graphical presentation of water stage in relationship to volumes of soil loss, bank features, and other site characteristics. The work products provided as part of this study will include:

1. a GIS shapefile of monitoring sites and table of site characteristics;

2. drafted, overlaid topographic cross sections showing changes at each site through time;

3. bar graphs showing estimated volumes of soil loss through time and segregated by bank features (e.g., composition, slope, height); and

4. line graphs showing variations in water stage through time overlaid with bar graphs showing volume of soil loss during the time between survey events;

An interim study report will be prepared after the first year of study is complete synthesizing the above deliverables into a narrative that addresses the study goals and issues raised in various study requests. The report will be provided to stakeholders for review and comment. A draft final study report will be prepared after the study analysis is complete in study year 2. Stakeholder comments on the draft final report will be included in the final study report with an explanation of any stakeholder comments not incorporated.

Interim and final study reports will be provided after completion of the first and second year, respectively, of field work associated with this study and Study 3.

Results and conclusions will be reported in either PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This study will be a 2-year study. Because final study reports are to be completed by September 2015 in keeping with the ILP schedule, two full seasons of monitoring is not possible, but two complete years of sampling over three seasons could occur. Site selection will be completed by October 15, 2013. Establishment of the monitoring sites could begin in late 2013 as well, permitting at least one round of surveying before winter 2013/2014 begins. A full year of monitoring would occur in 2014 and another partial year of monitoring completed in spring and early summer 2015. Hydraulic modeling (Study 4) will be integrated into the study after field sampling ends to analyze the relationship between shear stress and bank erosion. The monitoring results will then be incorporated in to final study reports for both this study and the Riverbank Erosion Study (Study 3).

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this 2-year study is $245,000.

REFERENCES

Kleinschmidt (Kleinschmidt Associates, Inc.). 2011. Lower Connecticut Shoreline Survey Report – 2010: Bellows Falls Project (FERC No. 1855), Wilder Project (FERC No. 1892), Vernon Project (FERC No. 1904). Prepared for TransCanada Hydro Northeast. Westborough, MA. March 2011.

Lawler, D.M. 1993. The Measurement of River Bank Erosion and Lateral Channel Change: A Review: Earth Surface Processes and Landforms 18:777–821.

NHFG (New Hampshire Fish and Game Department). 1998. New Hampshire Fish and Game Department Strategic Plan (1998–2010). Concord, NH.

Ridge, J.C. and F.D. Larsen. 1990. Re-evaluation of Antevs' New England Varve Chronology and New Radiocarbon Dates of Sediments from Glacial Lake Hitchcock: Geological Society of America Bulletin 102:889–899.

Simons, D.B., Andrews, J.W., Li, R.M., and M.A. Alawady. 1979. Connecticut River Streambank Erosion Study—Massachusetts, New Hampshire, and Vermont. Prepared for the U.S. Army Corps of Engineers, New England Division.

REVISED STUDY 3

RIVERBANK EROSION STUDY

RELEVANT STUDY REQUESTS

FERC-04; NHDES-21a, -21b, -21c; NHFG-21a, -21b, -21c; VANR-01; CRWC-01, -02, -03; Han-01; Lipfert-01; Lyme-Leb-McInt-01; Mudge-01; Rock-01; TwoRiv-03

STUDY GOALS AND OBJECTIVES

In their study requests, FERC, NHDES, NHFG, VANR, and others have identified water-level fluctuations and flow peaking from Wilder, Bellows Falls, and Vernon Project operations as a potential contributing factor to bank erosion and soil loss in project-affected areas. In response to those concerns, the goal of this study is to provide baseline data relative to erosion in project-affected areas.

The objectives of this study are to:

- determine the location of erosion in project-affected areas and compare these locations with previously compiled erosion maps (e.g., Kleinschmidt, 2011; Simons et al., 1979);
- characterize the processes of erosion (e.g., piping, slumping, and slips);
- ascertain the likely causes of erosion (e.g., high flows, groundwater seeps, eddies, and water-level fluctuations related to project operations); and
- identify the effects of shoreline erosion on other resources (e.g., riparian areas and shoreline wetlands, rare plant and animal populations, water quality, and aquatic and terrestrial wildlife habitat).

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

NHDES	• State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	• General goals related to healthy ecosystems to support fish and wildlife. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR	•	State water quality standards for designated uses of Class B waters relative to flow alteration, water-level fluctuations and anti-degradation provisions. The Connecticut River below Wilder dam is listed as impaired waters on the Section 303(d) due to flow alterations.

ASSOCIATION WITH OTHER STUDIES

A number of other studies should be completed in conjunction with this study. To determine if erosion might be related to project-related, water-level fluctuations and peaking downstream of the three dams, the Hydraulic Modeling Study (Study 4) and Operations Modeling Study (Study 5) will be critical in determining the flow velocity, stage, and duration along the riverbanks, all potential factors in the erosion process.

Flow deflection around sand/gravel bars and channel/valley constrictions are important factors in understanding the distribution of erosion, so the substrate-related results of the Aquatic Habitat Mapping (Study 7) will also be important for discerning the causes of erosion. A determination of how the amount and location of erosion has changed through time will be based primarily on the findings of the Historical Riverbank Position and Erosion Study (Study 1). Additionally, the Riverbank Transect Study (Study 2) will provide important information to be used in characterizing the processes of erosion and determining its causes.

All of the data collection for these studies could be completed simultaneously with this study, but, ultimately, the conclusions of this study will depend significantly on the results of those other studies. The results of this study will assist in drawing conclusions related to the Floodplain, Wetland, Riparian, and Littoral Habitats Study (Study 27). The Recreation Facility Inventory and Use and Needs Assessment (Study 30) will identify recreation sites that erosion may affect.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Considerable information is currently available that will be useful in this study. Much of this information has been detailed in the PADs, but the most useful sources of data are further described below. Simons et al. (1979) and Kleinschmidt (2011) previously mapped erosion in the project-affected areas. These data will provide the basis for determining whether the location and amount of erosion has changed through time and in response to significant flood events, such as Tropical Storm Irene. Erosion mapping has also occurred on other portions of the Connecticut River (Field Geology Services, 2004) and will provide important comparative information on erosion in areas not affected by the projects.

Surficial geology maps prepared on USGS 7.5-minute topographic quadrangles published by the New Hampshire Geological Survey are, or soon will be, available for most of the study area. NRCS soils maps have also been developed and are available online for most of the study area. The surficial geology and soils maps will provide critical baseline information on the erodibility and permeability of bank sediments, height of riverbanks, and valley constrictions, all important factors controlling erosion.

Glacial Lake Hitchcock occupied most of the Connecticut River Valley in the study area at the end of the last ice age, depositing thick sequences of varved lacustrine clays and other fine sediments. Geologists have investigated these sediments for many years (Ridge and Larsen, 1990), and a review of this literature will provide additional information on the location, thickness, and stratigraphy of such deposits and thus will be helpful for understanding the distribution of erosion sites.

All of the existing information described above will be important for understanding the distribution, processes, and causes of erosion, but additional information is needed to fill in areas for which surficial mapping has not been completed and to provide greater resolution of surficial features and subsurface stratigraphy than is currently available.

PROJECT NEXUS

The resource agencies requesting this erosion study consider project-related, water-level fluctuations and peaking flows downstream of dams to be potential causes of erosion. While Simons et al. (1979) attributes all water fluctuations to be a factor in erosion in the project-affected areas, they also distinguish the effects based upon more extensive, sustained periods of inundation followed by rapid drawdown from restricted, sub-daily inundation. Considerable erosion also occurs on free-flowing portions of the Connecticut River not influenced by dams (Field, 2004), so erosion would likely still be occurring in the project-affected areas if the dams were not present. Water-level fluctuations in general represent only one process increasing the potential for bank instability with the cumulative effect of multiple processes that either increase the driving forces of instability (e.g., high shear stress and water seepage) or decrease the resisting forces (e.g., loss of bank vegetation and loss of soil cohesion), ultimately, leading to erosion.

Consequently, although project operations could directly cause erosion, bank instability is most likely the result of the cumulative effects of both project and nonproject-related factors. Under some conditions, project operations could reduce bank erosion. Bank instability is greater where permeable sand layers occur above impermeable clay layers because water seepage out of the bank becomes concentrated along a single layer (Lawson, 1985). Bank stability in project-affected areas is likely greater in those areas where water-level fluctuations do not repeatedly expose a sand-clay interface in the bank sediments. Detailed information to be collected as part of this study on bank stratigraphy, depth to sand-clay interfaces, and their relationship to past water-level fluctuations is needed to confirm whether project operations are causing reductions in bank instability.

STUDY AREA AND STUDY SITES

The study area includes the shoreline of the Wilder, Bellows Falls, and Vernon impoundments, as well as the shoreline of the riverine reaches downstream of the Wilder and Bellows Falls dams, and is limited to approximately 1.5 miles downstream of Vernon dam to the lower extent of Stebbins Island.

Mapping of erosion and other bank features will be done continuously along all banks in the study area, including both eroding and non-eroding areas. Several specific sites of erosion were mentioned in study requests by New Hampshire landowners in towns near the Wilder impoundment and just downstream, including River Road in Lyme just south of the North Thetford Road, River Road located a quarter mile south of the East Thetford Bridge, Mudge and McIntyre properties in Lyme, and Pine Park in Hanover. The study area encompasses these sites as well as others known to be of concern to landowners, and information relevant to the site-specific requests will be gathered.

METHODS

The following methodology will be used for tasks completed in the listed order, if possible:

Literature Review

A review of published literature will be undertaken on riverine and reservoir erosion and additional geological/hydrological studies completed within or near the study area. A thorough review of the literature will provide a full understanding of fluvial processes on large rivers and documented causes of erosion on rivers and dam-regulated impoundments. Citing relevant literature to support conclusions drawn from other studies is a standard practice in all technical and scientific research.

Watershed Characterization

General information on the drainage basin area is already available in the PADs, but additional information is needed on valley width, meander dimensions, and tributary influences. An effort will be made to compare variations in conditions on the Connecticut River adjacent to tributaries with different land use and human effects (e.g., tributaries with dams vs. tributaries without dams). Watershed characterization is an essential element of geomorphic studies and is necessary for establishing relationships between different features (e.g., distribution of erosion relative to the position along or tightness of a meander bend).

Analysis of Historical Aerial Photographs, Topographic Maps, and Archival Information

The materials for this analysis will be gathered as part of the Historical Riverbank Position and Erosion Study (Study 1) and will be important for reconstructing river conditions prior to the construction of dams, effects of other human activities (e.g., channel straightening, railroad construction, and project operational changes) on channel migration, and the control of tributary confluences on channel morphology. A comparison of channel processes and rates of erosion before and after dam construction or operational changes may be possible depending on the information discovered. Historical documents can be a rich source of information for geomorphologists reconstructing historical fluvial processes and river channel locations (Gurnell et al., 2003). Furthermore, the use of historical ground photographs found in archival records collected for Study 1 may also be an important tool for documenting recent landscape change along rivers, particularly in New England (Bierman et al., 2005).

Bathymetric Survey

A bathymetric survey will be completed along 20 transects as part of the Riverbank Transect Study using a handheld depth sounder with an accuracy of 0.1 foot (Study 2). Additional, more comprehensive bathymetric information will be collected throughout project-affected areas as part of the Aquatic Habitat Mapping Study (Study 7) that will benefit numerous studies including this study. For this study, bathymetric information will be critical for determining the depth of water along the riverbanks and for revealing submerged bars that may be deflecting flow toward the riverbanks or formed in response to eddies at channel/valley constrictions. Conducting bathymetric surveys is a standard practice for geomorphic studies of large rivers.

Surficial Mapping of Geomorphic Surfaces (i.e., Floodplain, Glaciogenic Terraces) on the Connecticut River Valley Bottom

Surficial maps for most of the study area have been published by the New Hampshire Geological Survey and will provide critical information on the height of river banks, subsurface material, and location of valley constrictions. Supplemental information will need to be gathered in areas not mapped and to provide greater resolution where multiple geomorphic surfaces of varying heights may be present in proximity to the river's shoreline. The additional mapping will be completed with topographic maps, aerial photographs, and field checking of more complex areas. Geologists with years of research experience studying Glacial Lake Hitchcock deposits will also be consulted. If LiDAR data are collected as part of other studies (e.g., Study 4), the resulting topographic information will help further refine the surficial geology maps, but the mapping could occur without such data. Surficial geological mapping serves as baseline data for most geomorphology studies.

Field Mapping of Bank Conditions

Several channel and river bank features will be mapped continuously along the river, using the most recent digital LiDAR data and color imagery as a base map, to locate the beginning and end points of mapped features (e.g., an eroding bank). The channel and bank features that will be mapped in the field include: 1) bank heights (possibly supplemented with surficial mapping results); 2) bank stability (e.g., severely eroding, moderately eroding, and stable); 3) types of erosion features (e.g., piping, undercutting, slumping, and tension cracks); 4) bank composition (e.g., alluvial floodplain sediments, non-alluvial glacial or lake sediments, or bedrock supplemented with surficial mapping results); 5) grade controls (e.g., dams, waterfalls, bridges, and other valley constrictions); 6) past management activities (e.g., location of berming, straightening, bank armoring, and concentration of surface runoff); 7) depositional features (e.g., point bars, mid-channel bars, beaches, and delta bars at tributary confluences); and 9) other features (e.g., large wood accumulations, deep pools, and tributary confluences). One additional feature, the total width of mature trees growing along the river's edge, will be mapped directly from LiDAR data and color imagery. All of the mapped features will be input into a GIS database that will show the character of the channel and banks continuously along the river. Features mapped in other studies, e.g., the Floodplain, Wetland, Riparian, and Littoral Habitats Study (Study 27) and the Cultural and Historic Resources Study (Study 33), may provide additional data for those locations. The subdivisions to be used for mapping the various features (e.g., moderately eroding for bank stability and point bars for depositional features) will be based on established terms or will otherwise be carefully described and presented to the erosion working group for feedback before mapping begins.

The mapping will be completed using a hand-held ArcPad computer with an embedded Trimble GPS and will allow mapped data to be immediately input as a GIS shapefile. LiDAR data and color imagery depicting the study area will be loaded into the ArcPad computer to assist in accurately locating the position of mapped features. The analysis of GIS data of mapped features will provide: 1) statistical information on individual features (e.g., total length of eroding banks and percentage of channel banks that are bedrock); 2) comparative information between features (e.g., location of eroding banks in relationship to areas of concentrated runoff); 3) a means of identifying the causes for certain channel conditions (e.g., eroding banks adjacent to mid-channel bars); and 4) a method for the rapid viewing of multiple parameters at the watershed scale (e.g., the distribution of erosion relative to the location of clay banks). Consequently, the mapping of channel features will be critical for determining the causes of erosion. The mapping of channel features is a common methodology in fluvial geomorphology and the techniques to be used are similar to the United States Environmental Protection Agency's (USEPA's) National Hydrography Dataset Reach Indexing Tool.

Stratigraphic Descriptions

The composition of bank material will be characterized during the field mapping of bank conditions. However, the layering of sediments within the banks can play an instrumental role in bank stability with contacts between permeable sand above impermeable clay providing a zone along which water can preferentially seep out of the bank. Consequently, identification of the various sedimentary layers within a bank is critical to understanding the distribution and causes of erosion. Stratigraphic descriptions of at least 20 bank exposures will be completed as part of the Riverbank Transect Study (Study 2), but additional descriptions will be needed to fully characterize the range of conditions present in the study area. At least one stratigraphic column will need to be measured for each geomorphic surface identified during surficial mapping. Linking stratigraphic descriptions to geomorphic surfaces will enable generalizations of stratigraphic layering to be made over a broad area because stratigraphy will be generally uniform for a given surface. This will limit the effort needed to describe subsurface stratigraphy and will provide information on stratigraphy even where bank exposures are obscured due to vegetation, riprap, or other reasons. The stratigraphic descriptions will be completed using standard geological and soil techniques with the elevation of the top and bottom of each observed stratigraphic layer measured relative to the top of the bank with a measuring tape or stadia rod. The true elevation of the reference point at the top of the bank will be determined using survey grade GPS because the true elevation of stratigraphic contacts will be needed to make comparisons with water surface elevations established through hydraulic modeling. In relationship to known reference points, the accuracy of the GPS surveys should be within 0.2 foot horizontally and vertically but will depend on the distance from the base station. Each stratigraphic layer will be described in terms of texture (i.e., grain size), color, internal bedding, permeability, and other characteristics useful for determining the depositional environment of the sediment (e.g., lake, floodplain, and delta). Stratigraphic descriptions are a common methodology used in many geomorphology studies.

Topographic Surveying

Topographic cross sections of the banks will be completed at 20 sites as part of the Riverbank Transect Study (Study 2) to closely monitor erosion over 2 years and better characterize the processes of erosion. However, additional surveying, including cross sections and plan maps, will need to be completed for other purposes in this study including comparing bank slopes of stable and eroding banks, determining the shapes and dimensions of slump features, and measuring the amount of bank recession that has occurred around fixed features (e.g., bridge abutments and riprap). Surveying will be completed with a Sokkia Set 5 total station with accuracy greater than 0.1 foot given that such surveys will not need to be tied into a known datum as will those for the stratigraphic descriptions. Topographic surveying is an integral part of most geomorphology studies, and the standard surveying techniques used in such studies are described by Simon and Castro (2003).

Hydraulic Modeling

HEC-RAS one-dimensional (1-D) hydraulic modeling is being completed of the entire study area as part of the Hydraulic Modeling Study (Study 4). HEC-RAS modeling will provide information on flow stage, velocity, and shear stress, important factors in the erosion process. The FERC study request for a riverbank erosion study specifically requests that “bank shear assessments” be completed to compare different sites for their susceptibility to erosion, a request that will be the focus of the Riverbank Transect Study (Study 2). For this study, two-dimensional (2-D) modeling at up to six sites using River2D may be necessary to understand complex sites where HEC-RAS modeling does not adequately describe eddy flows that might develop, for example, upstream of valley constrictions or flow deflection that might occur, for example, around a mid-channel bar or island. 1-D modeling assumes all flow is moving uniformly in a single, downstream, direction, where in reality a portion of the flow is often moving across the channel or even upstream as in an eddy. The 2-D modeling will occur in areas where such variations in flow direction are considered to be an important factor contributing to bank instability.

2-D modeling, if necessary, will occur in conjunction with the Instream Flow Study (Study 9), and only at selected sites extending over only hundreds of feet of river.

The methods described above were selected to match as closely as possible those recommended in the relevant study requests, and the overall study approach has been crafted to address concerns raised in the various study requests and scoping meeting comments.

ANALYSIS

The data collected as part of this study will be analyzed within the context of the four study objectives of identifying the location, processes, causes, and potential effects of erosion. Changes in the location of erosion through time will be achieved through comparisons of at least 3 map years of GIS data (1979, 2010, and to be completed in 2014) with pie charts and maps to be used to determine if river bank erosion has increased through time as suggested in some of the study requests. Historical maps and aerial photographs to be compared during the Historical Riverbank Position and Erosion Study (Study 1) may be useful for extending the temporal record of how the location and amount of erosion has changed through time.

Information collected on bank characteristics at multiple places within the study area will be compared with erosion processes described in the literature to establish how erosion proceeds through time at a given site. The results of this analysis will be presented as a channel evolutionary model that will illustrate with photographs, sketches, and tables how the morphology of the riverbank changes through time as erosion progresses and material is shifted from the upper bank to the lower bank and ultimately transported downstream. Information gathered during the Riverbank Transect Study (Study 2) will also be used in developing the evolutionary model of bank erosion.

An analysis of erosion causes will be completed by identifying the propensity of erosion to occur in association with certain conditions. For example, erosion focused in areas where sand-clay interfaces are frequently exposed due to water-level fluctuations may suggest project operations are partially responsible for the erosion. Conversely, the presence of significant erosion on the outside bend of meanders may suggest higher shear forces from natural flood flows are contributing to bank erosion. The results of the Hydraulic Modeling Study (Study 4) and the Riverbank Transect Study (Study 2) will be important in establishing these associations and identifying the major factors contributing to erosion.

Maps showing the location of different bank conditions and features along the river will be used to investigate whether bank erosion has the potential to affect other resources. For example, if erosion is occurring where riparian vegetation is present riparian habitat could be considered potentially affected by bank failure with the results of the Floodplain, Wetland, Riparian and Littoral Habitats Study (Study 27) to be integrated with this study. Similar associations may also be established to identify possible effects on aquatic habitat. Habitats sensitive to fine sediment deposition, such as spawning gravel, could be considered threatened if considerable lengths of bank erosion are occurring immediately upstream. The Channel Morphology and Benthic Habitat Study (Study 8), Aquatic Habitat Mapping Study (Study 7), and the Recreation Facility Inventory (Study 30), as well as several fish spawning studies (e.g., Studies 14, 15, and 16), will be needed to identify whether and where effects on other resources are occurring as the result of bank erosion.

To the extent possible, all of the collected data and subsequent analysis will be incorporated into a GIS database with maps and attribute tables that can be readily shared with interested stakeholders. TransCanada will consult with the erosion working group periodically to solicit comments to strengthen data collection procedures, analysis of erosion causes, and continuing studies during the 2-year study period.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The various methods to be used in the Riverbank Erosion Study conform to generally accepted scientific practice as detailed in the Methods section above. A further evaluation of the proposed study methods will be conducted during the literature review at the outset of the study to ensure all of the work is conducted using established standards.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. The report will include GIS shapefiles of monitored sites, topographic cross sections showing changes through time, graphical presentation of water stage in relation to volumes of soil loss, bank features, and other site characteristics. The work products to be completed as part of this study will include:

1. an annotated bibliography of local studies and published literature describing how a particular document relates to one or more of the study goals;
2. tables and figures documenting and illustrating how the character of the watershed (e.g., drainage area), valley (e.g., width), and channel (e.g., meander dimensions) vary in a downstream direction;
3. maps showing long-term trends in channel migration and bank erosion;
4. bathymetric contour maps and/or cross sections showing how the depth of the river varies across the river at selected sites;
5. surficial geology maps of the Connecticut River Valley bottom within the study area presented on 7.5-minute topographic quadrangles;
6. GIS shapefiles and summary tables of channel conditions for more than 300 miles of shoreline;
7. figures and tables of the stratigraphic and soil descriptions of bank sediments;

8. topographic cross sections and plan maps illustrating important bank and channel conditions;

9. maps and cross sections illustrating how flow stage, velocity, and shear stress vary with discharge for various points along the river based on hydraulic modeling results; and

10. an interim and final study report synthesizing the above deliverables into a narrative that addresses the study goals and issues raised in various study requests.

The interim study report will be prepared after the first year of study is complete. The report will be provided to stakeholders for review and comment. A draft final study report will be prepared after the study analysis is complete in study year 2. Stakeholder comments on the draft final report will be included in the final study report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This study will be conducted as a 2-year study. The literature review, watershed characterization, and mapping of geomorphic surfaces could begin in late 2013, following FERC's study plan approval, or in early 2014 with field mapping, supplementary topographic and bathymetric surveying, and stratigraphic descriptions completed in summer and fall 2014. Hydraulic modeling will be integrated into the study at the outset of 2015 to analyze the effects of large floods and water-level fluctuations on bank erosion. Information from other studies will also be integrated into this study during 2015 to address project goals and analyze the results.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this study is $460,000.

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REVISED STUDY 4

HYDRAULIC MODELING STUDY

RELEVANT STUDY REQUESTS

FERC-01; FWS-01; NHDES-14a; NHFG-14; VANR-04; CRWC-11; TNC-01; TU-07

STUDY GOALS AND OBJECTIVES

In their study requests, FERC, FWS, NHDES, NHFG, VANR, CRWC, TNC, and TU indicated an interest in understanding the effects of changing flows and water surface elevations at the Wilder, Bellows Falls, and Vernon Projects on environmental resources. The goal of this study is to develop a hydraulic model to derive hydraulic indices and parameters such as water surface elevations, velocities, and flows across the study area and at locations of interest identified in other studies. The results of the hydraulic model will on its own, or in conjunction with, the Operations Modeling Study (Study 5) inform other studies, thereby permitting the evaluation of the effects of project operations on aquatic, terrestrial, and geologic resources.

The objectives of this study are to:

- develop relationships between water levels and flows throughout the project reservoirs and affected downstream reaches; and

- provide information regarding specific relationships at econodes of interest to the Operations Modeling Study (Study 5).

The study requests also identify an interest in understanding how operations at the three TransCanada projects affect operations of the FirstLight projects (Northfield Mountain Pumped Storage [FERC No. 2485] and Turners Falls [FERC No. 1889]), which are beyond the scope of TransCanada's hydraulic and operations models and are the responsibility of FirstLight in developing that determination. TransCanada will provide FirstLight with output from its models in the form of discharge at Vernon dam. This output will serve as the upstream inflow in the model FirstLight develops to assess the effect on its operation.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

Federal and state resource agencies described various jurisdictional resource management goals for this study in their requests, as summarized below:

FWS

- General goals for relicensing including ensuring that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives and conserving, protecting, and enhancing habitats for fish, wildlife, and plants affected by the projects.

- General goals related to aquatic resources including protection, enhancement, or restoration of aquatic and riparian habitats; providing instream flows to meet the requirements of diadromous and resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.

NHDES

- State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.

NHFG

- General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR

- State water quality standards for designated uses of Class B waters relative to flow alteration, water-level fluctuations, and anti-degradation provisions. The Connecticut River below Wilder dam is listed as impaired waters on the Section 303(d) list due to flow alterations.
- General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.

ASSOCIATION WITH OTHER STUDIES

The operations model developed in Study 5 will use the hydraulic indices and parameters from this study and derive a time-series database of hourly water levels and flows from operational scenarios. At a minimum, the results of this study and Study 5 will be used to assess potential project effects on the following: erosion processes (Studies 1, 2, and 3); aquatic resources (Studies 7, 8, 9, 12, 13, 14, 15, 16, 21, 24, 25, and 26); terrestrial resources (Studies 26, 27, 28, and 29); cultural and historic resources (Study 33) and recreation and aesthetic resources (Studies 31 and 32). Figure 4-1 illustrates the relationships among the operations and hydraulic models and resource studies.

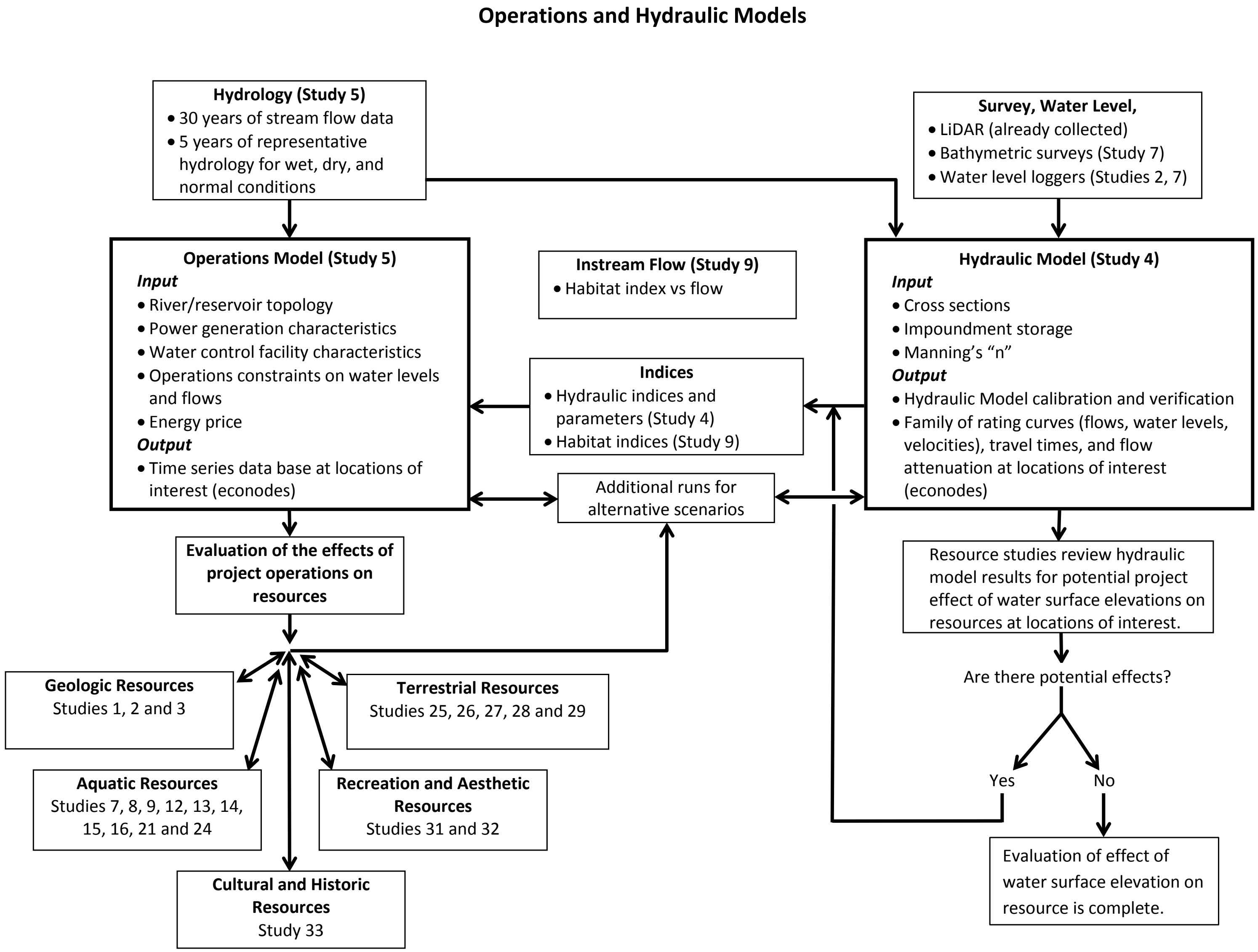

Figure 4-1. Relationship among models and resource studies.

There may be instances when the results of the hydraulic model will be used to establish that a particular resource is not affected by project operations due to its location outside the zone of influence or due to an upland position in terms of elevation. In these cases, there is no need to use the operations model to examine potential impacts on a time-series basis. Determination of "no effect" in these cases will be based on the results of the hydraulic model.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

The PADs for the Wilder, Bellows Falls, and Vernon Projects provide detailed information on current project operations including normal operations, inflow, river profile operation, and high-flow operation. The PADs also provide information on the existing environment and resource effects. Currently, however, there is no tool that enables correlation of current project operations related to flows and water levels to observed shoreline phenomena (e.g., erosion), habitats, and distribution of biota at various locations other than at the dam or tailraces immediately downstream. This study coupled with the Operations Modeling Study (Study 5) is designed to provide that determination.

PROJECT NEXUS

The three project dams are operated to pass daily inflows and maintain water levels in the impoundments in accordance with conditions established in the current license and in response to daily hydrologic conditions and energy prices. Operations modeling facilitates the optimization and simulation of detailed hourly operations over an annual period based upon those variables. The operations model, discussed in more detail in Study 5, will inform short-term operations scheduling by simulating the optimization of complex characteristics of energy pricing, inflows, minimum flows, and impoundment and tailwater conditions.

No changes are proposed to project operations and, therefore, no new effects on environmental resources from operations are anticipated. For long-term planning purposes, and in light of the potential for expected variability in hydrology and energy pricing, the operations model (Study 5) will inform operations to balance license, hydrologic, energy, and environmental resource conditions.

The hydraulic modeling conducted as part of this study will provide a means to develop hydraulic indices and parameters including flow and water levels at locations of interest to provide information to the operations model (Study 5) to inform specific study objectives of other the studies cited above.

STUDY AREA AND STUDY SITES

The hydraulic model study area will include the main stem of the Connecticut River extending from immediately downstream of McIndoes dam to approximately 1.5 miles downstream of the downstream boundary of Vernon dam.

METHODS

The HEC-RAS software, Version 4.1.0 (USACE, 2010) will be used in this study to develop a 1-D hydraulic model of the study area. FERC referenced use of the HEC-RAS model in its study request.

The hydraulic model will be developed to simulate routing of river flow through the three impoundments and downstream sections in the study reach of the Connecticut River to a point approximately 1.5 miles downstream of the downstream boundary of Vernon dam. River reach characterization will be performed by the selection of cross section locations using the Environmental Systems Research Institute (ESRI) GIS (ArcGIS), Version 10.0 (ESRI, 2010), and HEC-GeoRAS, Version 10 (USACE, 2012). HEC-GeoRAS is an ArcGIS software extension that incorporates mapping and data processing capabilities of HEC-RAS through the ArcGIS program interface.

Cross sections will be placed around hydraulic structures, stream junctions, and locations of interest identified by other ILP studies. Cross-section locations will be based on river morphology to capture changes in channel and floodplain width, slope, and storage. Cross-section elevations will be based on a digital elevation model derived from the LiDAR survey data provided by TransCanada, and augmented by topographic and bathymetric survey data collected in Study 7 (Aquatic Habitat Mapping) and at locations of interested identified by other studies.

Project LiDAR data acquisition was initiated in 2013 and included a LiDAR survey conducted by U.S. Imaging, Inc. Surveys were performed April 26 through May 8, 2013, over an approximately 1-mile-wide swath that was centered on the study reach of the Connecticut River. To perform the LiDAR survey, the system was flown for 34.2 hours at a height of 1,066 meters above ground level and a speed of 120 knots traveling from south to north. The LiDAR system settings and flight parameters yielded a density of 3.8 points per square meter on a single flight line with 35 percent overlap for a resulting density of about 5 points per square meter.

Specific steps to develop the HEC-RAS hydraulic model for the study area are as follows:

1. Hydraulic Model Setup:

    a. A single digital elevation model of the study reach will be developed that includes topographic (LiDAR) and bathymetric survey data.

    b. Cross sections will be developed in GIS from LiDAR (TransCanada), bathymetry (Study 7), and project data (dam dimensions and elevations). Cross section placement will include locations of interest to the hydraulic model, econodes identified in the operations model (Study 5) and locations of interest identified by other resource studies.

    c. Manning's n-values will be preliminarily assigned for the main channel and overbanks based on a combination of readily available field and photographic observations, published sources, and standard references (Chow, 1959; Barnes, 1967).

2. Hydraulic Model Calibration and Validation:

   a. The HEC-RAS model will be calibrated to optimize model replication of observed data. Calibration will be based on a range of observed flows and water surface elevation data from USGS gages in the study reach and from water-level logger data (Studies 2 and 7). Observed data, such as water surface elevations, travel time of operational pulses, and attenuation of flows, will be compared to simulated HEC-RAS model data.

      i. USGS gage locations and data will be reviewed for the hydrology data set used in the operations model (Study 5) that represent wet, dry, and normal conditions, and gage data will be selected for use in calibration.

      ii. The hydrology data set from the operations model will be routed in the HEC-RAS unsteady flow model to compute water surface elevations along the study reach for the wet, dry and normal conditions. The three project impoundments will be modeled with dynamic routing using the St. Venant equations of Conservation of Mass and Conservation of Momentum (USACE, 2010).

      iii. Water surface elevations, flows, and travel times of operational pulses computed in HEC-RAS will be compared to the observed USGS gage data.

      iv. Manning's n-values will be adjusted in the HEC-RAS model, within an acceptable range, to achieve a "best match" to the observed data.

   b. Water-level logger data measured in 2013 (Studies 2 and 7) will be used for validation of the calibrated HEC-RAS model, as necessary, applicable, and available.

      i. Three flow events (wet, dry, and normal) will be identified for the period July through November 2013 using USGS gage data.

      ii. The HEC-RAS unsteady flow model will be used to simulate up to three flow events.

      iii. Water surface elevations computed using the HEC-RAS model will be compared to water-level logger and/or USGS gage data.

   c. Velocities measured in 2013 will be compared to average velocities computed by the HEC-RAS model, as available and applicable.

b. Travel time of operational pulses and flow attenuation information will be provided to operations model (Study 5) for operations model routing.

3. Sub-Hourly Flow and Elevation Rate-of-Change:

a. The hydraulic modelers will perform HEC-RAS model runs to compute the sub-hourly flow and elevation rate-of-change at locations of interest.

i. Operations modelers will provide hydraulic modelers with up-ramp and down-ramp flows across a 24-hour period for 5 scenarios.

ii. Hydraulic modelers will perform sub-hourly HEC-RAS model runs to compute the flows and water surface elevations at locations of interest for each scenario.

iii. Hydraulic modelers will provide the sub-hourly time-series flows and water surface elevations to Studies 3, 8, and 9 for five scenarios, 24-hours each.

iv. Resource studies will assess the need to consider alternatives and inform the operations modelers.

v. In the event there is a need to consider alternatives, the operations modelers will modify the unit loading and unloading procedures, configure the hourly operations model with sub-hour routing and operations procedure, and provide the resulting sub-hourly up-ramp and down-ramp flows and water surface elevations to resource studies, as applicable.

vi. Figure 4-2 illustrates the relationship between the operations model, hydraulic model and resource studies for the sub-hourly flow and elevation rate of change.

4. Rating Curves for Operations Model:

a. Operations modelers will provide a range of discharge versus reservoir elevation conditions at the hydroelectric facilities.

b. Using the calibrated and validated HEC-RAS model, a family of flow versus stage rating curves will be developed at econodes of interest for the range of discharge and reservoir elevations.

c. The rating curves will be provided to the operations modelers in spreadsheet format.

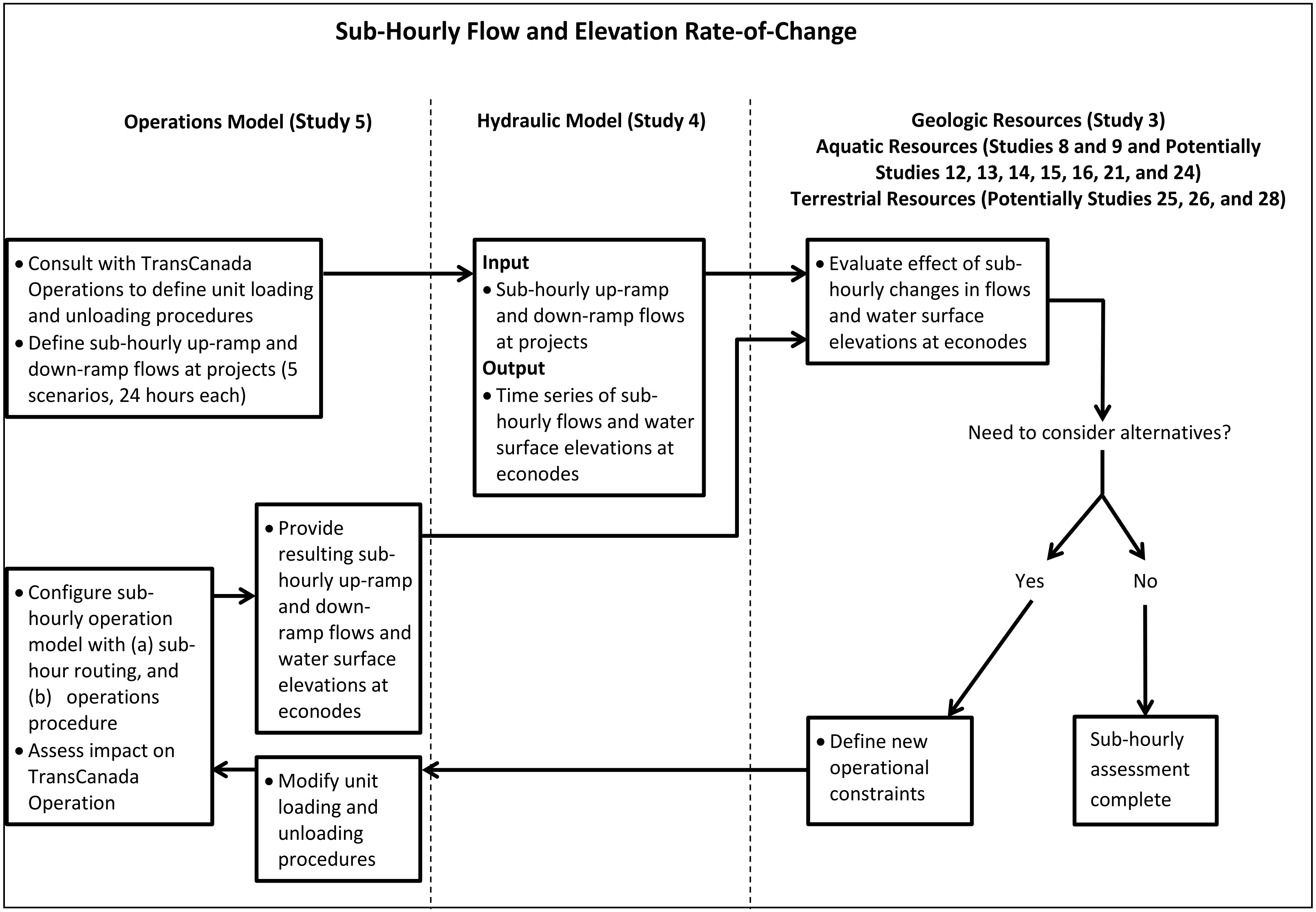

Figure 4-2. Sub-hourly rate-of-change.

The method for integration of this study with the Study 5 operations model and other resource studies that will depend on hydraulic modeling to interpret project effects will occur by the following process:

1. The existing operations model will be updated for base operating conditions (see Study 5).

2. Topographic and bathymetric surveys, which will be collected as part of other resource studies, will be provided to the HEC-RAS modelers for hydraulic model setup. Hydraulic data collected as part of other field resource studies will be provided to the HEC-RAS modelers for use in validation, as applicable and available.

3. The HEC-RAS model will be set-up and run to derive the following relationships:

    a. water level as a function of flow rate at the econode for riverine sections;

    b. water level as a function of flow rate at the econode and the water level at the downstream reservoir, for backwater sections; and

    c. routing characteristics for main stem river reaches (lag time and routing/ attenuation parameters).

4. The operations model will be run using the hydraulic parameters derived from the HEC-RAS model. Data summarizing the effects at locations of interest will inform the other resource studies.

5. Additional model refinements will be made to both the HEC-RAS and operations models based on other resource studies and working group comments; and additional model runs will be made as applicable.

ANALYSIS

Hydrology and operation scenarios will be provided by the operations model (Study 5) for use in the hydraulic model. The hydraulic parameters derived from the hydraulic model will then be formatted into hydraulic index curves for use in the operations model.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The USACE designed the HEC-RAS software program to perform 1-D hydraulic calculations for natural and human-made channels. HEC-RAS is widely used and accepted by the engineering community and regulatory agencies. For example, this model is the standard for USACE projects; FEMA has accepted HEC-RAS for performing national flood insurance studies; NRCS has adopted HEC-RAS as its main river hydraulics model; the Federal Highway Administration has accepted it for its use on highway hydraulics studies; and many state and local agencies across the country have also adopted HEC-RAS for use in hydraulic studies. HEC-RAS has become a standard in the industry for river hydraulic modeling.

DELIVERABLES

Hydraulic parameters will be developed and provided for use in the operations model and for analysis of project effects on resources that are the subject of other studies. A report will be prepared that presents methods, analysis, and results of the study.

A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license applications for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

The hydraulic model will be preliminarily set up starting in January 2014. Refinements to the model will be made in the first study year (2014) after 2013 field work (bathymetric surveys from Study 7 and water-level logger data from Studies 2 and 7) becomes available. Model calibration and validation will be performed in 2014. Additional model refinements, and model runs will be made during the second study year (2015), as applicable.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this study is approximately $170,000 for work performed in 2014. The preliminary estimated cost for work to be performed in 2015 cannot be determined at this time and will be based on the specific areas of interest identified in other resource studies and on the results of analysis performed from those studies.

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REVISED STUDY 5

OPERATIONS MODELING STUDY

RELEVANT STUDY REQUESTS

FERC-01; FWS-01; NHDES-14a; NHFG-14; VANR-04; CRWC-11; TNC-01; TU-07

STUDY GOALS AND OBJECTIVES

In their study requests, FERC, FWS, NHDES, NHFG, VANR, RWC, TNC, and TU indicated an interest in understanding the effect of operations at the Wilder, Bellows Falls, and Vernon Projects on environmental resources. The goal of this study is to develop an operations model that will provide information on the effect of flows and water levels, resulting from hydrology and operational scenarios, on environmental resources.

The objective of this study is to develop a time-series database of hourly water levels and flows for various selected operational scenarios, to enable other studies to assess the effects of project operations on aquatic, terrestrial, and geologic resources at locations of interest. The values will be available at many locations on the river system, including the three projects and identified areas of interest (econodes).

Study requests also identify an interest in understanding how operations at the three TransCanada projects affect operations of the Northfield Mountain Pumped Storage Project (FERC No. 2485) and Turners Falls Project (FERC No. 1889). That is beyond the scope of TransCanada's hydraulic and operations models and is the responsibility of FirstLight to develop that determination. TransCanada will, however, provide FirstLight with output from its models in the form of discharge at Vernon dam. This output will serve as the upstream inflow in the model FirstLight develops to assess the effect on its operation. This two-model approach (TransCanada-FirstLight) will effectively meet the agency and stakeholder requests but will preserve the separation of operations decisions, which is a necessity and requirement within the power market in which both TransCanada and FirstLight operate the businesses.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

Federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS

- General goals for relicensing including ensuring that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives and conserving, protecting, and enhancing habitats for fish, wildlife and plants affected by the projects.

- General goals related to aquatic resources including protection, enhancement, or restoration of aquatic and riparian habitats; providing instream flows to meet the requirements of diadromous and resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.

NHDES

- State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.

NHFG

- General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR

- State water quality standards for designated uses of Class B waters relative to flow alteration, water-level fluctuations, and anti-degradation provisions. The Connecticut River below Wilder dam is listed as impaired waters on the Section 303(d) due to flow alterations.
- General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.

ASSOCIATION WITH OTHER STUDIES

The Vista Decision Support System (Vista DSS™) operations model, used in this study, is TransCanada's central tool for assessing project effects on aquatic, terrestrial, and geologic resources under the current operating scenarios. It also has the capacity to evaluate alternative operational scenarios and their potential to mitigate effects on resources.

The model will provide long time-series of hourly values for:

- power generations at hydroplants;
- water levels at reservoirs and econodes; and
- flows at upstream and downstream end of each river reach and econodes

An econode is an area of interest as defined in one of the resources studies.

Completion of this study depends on hydraulic parameters from the hydraulic model (Study 4). The parameters provided from Study 4 include:

- rating curves for econodes on riverine segments:
  - relationship between flow rate and water surface elevation,
  - relationship between flow rate and average section velocity, and
  - relationship between flow rate and average section shear stress;
- rating curves for econodes on backwater river segments:
  - relationship between flow rate and downstream reservoir elevation, and water surface elevation,
  - relationship between flow rate and downstream reservoir elevation, and average section velocity, and
  - relationship between flow rate and downstream reservoir elevation, and average section shear stress;
- several time-series of flow at every econode, to be used to derive routing characteristics of river reaches.

Completion of this study depends on aquatic parameters from Aquatic Habitat Mapping (Study 7) and Instream Flow (Study 9), including the relationship between the defined fishery index and the econode flow rate and water surface elevation.

At a minimum, the results of this study (time-series of flows, water levels, velocities, shear stress and aquatic habitat indices) will be used to assess project effects on the following:

- erosion processes (Studies 2 and 3);
- aquatic resources (Studies 8, 12, 13, 14, 15, 16, 22, and 24);
- terrestrial resources (Studies 25, 26, 27, 28, and 29); and
- recreation and aesthetic resources (Studies 31 and 32).

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

The PADs for the Wilder, Bellows Falls, and Vernon Projects provide detailed information on current project operations including normal operations, inflow, river profile operation, high-flow operation, and flood control and navigation. The PADs also provide information on the existing environment and resource effects. However, currently, no tool is available to enable correlation of current project operations related to flows and water levels to observed shoreline phenomena (e.g., erosion), habitats, and distribution of biota. This study coupled with the hydraulic model (Study 4) is designed to provide that tool.

PROJECT NEXUS

The three projects are operated to pass flows and maintain water levels in the impoundments in accordance with conditions established in the current license and in response to daily hydrologic conditions and energy prices.

In an operations environment, modeling facilitates the optimization of detailed hourly operations on a continuous basis, considering the key input variables and objectives. The inputs include inflows, constraints on impoundment water levels and river flows, and market prices. Objectives are first to meet defined constraints and then maximize the value of energy generation with the flexibility that remains. In the study environment, the modeling simulates or mimics the above stated process.

No changes are proposed to project operations; therefore, no new effects on environmental resources from operations are anticipated. For long-term planning purposes, and in light of the potential for expected variability in hydrology and energy pricing, the operations model will simulate the operations process, which balances license, hydrologic, energy generation, and the environmental resource conditions.

The modeling conducted under this study will provide a key link to understanding hydraulic parameters, such as flow and water levels at locations of interest, to meet specific study objectives of the other studies cited above.

STUDY AREA AND STUDY SITES

The operations model was developed to simulate operations of the Wilder, Bellows Falls, and Vernon Projects. Dams at these three projects create three impoundments, which are represented as "headponds" in the operations model. The model also includes the upstream Dodge Falls Hydroelectric Project (FERC No. 8011) and the Fifteen Mile Falls Project (FERC No. 2077). Three upstream storage impoundments—Lake Francis, First Connecticut Lake, and Second Connecticut Lake—are also included in the operations model.

The study focus area for the model is the Wilder, Bellows Falls, and Vernon Projects and their effects. Several large tributaries to the Connecticut River are included in the study area as hydrology inflow points for the operations modeling. These tributaries include Passumpsic, Waits, Ompompanoosuc, White, Ottaquechee, Black, Williams, and West rivers in Vermont and the Ammonoosuc, Mascoma, Sugar, and Cold rivers in New Hampshire. In addition to tributary inflows, the hydrology developed for the operations model also includes uniform lateral inflows from upland watersheds.

METHODS

The Vista DSS™ software system developed by Hatch Ltd will be used in this study. Vista DSS™ is a proprietary system that provides a framework to model detailed operations of water resources and hydroelectric operations. It comprises nine integrated modules, under a Windows operating system, and uses robust database technologies and a sophisticated Windows user interface.

Vista DSS™ is a network flow model that uses optimization methods to determine a realistic and representative operation of generating/pumping units, water control structures, and associated effects in river reaches and reservoirs. It is used primarily to first reliably meet license conditions (including minimum flows and impoundment limits), and then to maximize value from energy production. A cornerstone of the model is the continuous determination of optimum operational actions on an iterative basis, responding to changing conditions such as hydrologic inflows and energy pricing.

The model consists of a series of nodes (point locations) and arcs (flow paths) to define specific system features, such as hydrology (inflows from tributaries and upstream watersheds), river junctions, impoundments, tailwater, spillways, and power generating units. In the model, econodes represent specific areas of interest. Econode results (e.g., water levels and flows) from the operations model will provide an understanding of their effect on environmental resources.

Specific steps to develop the operations model include:

- Revise the operations model, originally developed in 1992, in the following areas:
  - Update the generating unit performance characteristics.
  - Update the operational constraints (license conditions).
  - Update the model hydrology dataset through 2011, thus having 30 years of hydrology available for the study. Each year of hourly analysis will yield 8,760 data points for each result variable of interest.

    A representative 5-year subset of the available 30 years of inflow was selected for use in the current study. The selection was based on ranking annual and spring total inflow volumes at the Vernon Project and the system annual energy production from the lowest value (1) to the highest (30). Note that the lowest rank (1) corresponds to the lowest inflow volume (driest year) and by searching for seasonal variability between the five selected hydrologies.

The selected years are 1992, 1994, 1989, 2007, and 1990, corresponding to the following ranks:

- 5, 9, 14, 20, and 25 ranking (out of 30) of the annual total inflow volume at the Vernon Project. Dividing by the sample size of 30, the associated percentiles are 17 percent, 30 percent, 47 percent, 67 percent, and 83 percent (dry to wet progression);
- 6, 16, 12, 21, and 22 ranking of the annual spring inflow volume at the Vernon Project; and
- 3, 8, 15, 22, and 28 ranking of the system annual energy production.

It is not necessary to use all available hydrology for the study because the information on operational impacts can be provided by a properly selected representative subset of the hydrology. The selected subset represents a range of flow conditions both annually and seasonally. The subset also represents a wide range of annual energy production and thus reflects the actual TransCanada regulation effects in the river regime.

- Update the model with econodes that define areas of interest as identified from other resource studies.
- Define econode elevation relationships with flows and downstream node elevations using the hydraulic model results developed from Study 4.
- Define new river reaches, associated with the updated econodes, and the routing parameters.
- Update econode environmental assessment indices rating curves (function of flow and/or elevation) from other studies.
- Define hourly market energy prices, which will guide hourly energy production. The hourly day-ahead price schedule for 2010 was selected for the model because it was deemed to be representative of the seasonal and within-week fluctuating nature of historical market prices. However, hourly fluctuations in historical market price typically reflect market conditions at the time that may not be present at the same time in another year. Therefore, to be more representative of TransCanada operations, the 2010 hourly prices were filtered by deriving the average hourly weekday and weekend prices for each month for use in the model. The filtering is done by averaging each weekday-hour value (and each weekend-hour value) with all values available in the month. For example, the January weekday (Monday to Friday) 10 a.m. price is taken as the average of the 23 values that occur in that month. Similarly, the January weekend (Saturday and Sunday) 10 a.m. price is taken as the average of the eight values that occur in that month. Thus, there is an hourly pattern over the week, which is then applied throughout the month. This

pattern is representative of the hourly pattern over the week but with much-reduced noise.

- Run the operations model for a range of baseline operating conditions using the five representative hydrology years.

- Provide time-series database of hourly water levels and flows and associated assessment indices to enable other studies to assess the effects of operations on environmental resources at locations of interest. The time-series database will enable assessments regarding the variability, rate of change, and frequency of fluctuation within the impoundments and tailraces based on criteria and areas of interest identified by other studies.

PROCESS

The method for integrating this study with the Hydraulic Modeling Study (Study 4) and other resource studies to interpret project effects follows:

1. The existing operations model will be updated for base operating conditions (discussed under the Methods section).

2. Topographic and bathymetric surveys, which will be collected as part of other resource studies, will be provided to the HEC-RAS modelers for hydraulic model setup. Hydraulic data collected as part of other field resource studies will be provided to the HEC-RAS modelers as a check/calibration step for model flow, elevation, and velocity at the specific locations where data were collected.

3. The HEC-RAS model will be set up and run in a steady-state mode, for a range of flow and headpond levels, to derive the following relationships:

   a. econode water level as a function of flow rate at the econode for riverine sections;

   b. econode water level as a function of flow rate at the econode and the water level at the downstream reservoir for backwater sections; and

   c. econode velocity as a function of flow/elevation at the node.

4. The HEC-RAS model will be run in dynamic mode for a number of selected flow sequences to derive the lag and route characteristics of the various river reaches.

   The operations model uses Muskingum Cunge hydrologic routing method to derive outflow at the downstream end of a river reach from inflow at the upstream end. The parameters of the model for all main stem river reaches (lag time, and routing/attenuation parameters) will be derived from the time-series of inflow to and outflow from the reaches obtained from the HEC-RAS model.

5. The operations model will be run using the above hydraulic parameters derived from the HEC-RAS model. The model will be run for the current status quo operations scenario and data summarizing the effects at locations of interest will inform the other resource studies.

6. Additional model refinements will be made to the operations models based on other resource studies, and additional model runs will be made for various alternative operations scenarios as needed to evaluate potential effects on a variety of resources (e.g., erosion, fisheries and aquatics, and terrestrial) based upon discussions and proposals put forth through working group discussion of resource study results that examine existing operational impacts.

SUB-HOURLY MODEL CONSIDERATION

Sub-hourly modeling refers to the case in which the model time granularity is shorter than 1 hour; for example a 5-minute time step.

The need for sub-hourly modeling to evaluate the effect of rapid flow changes due to unit loading and unloading will be jointly investigated among the pertinent study groups as outlined in the following steps:

1. The operations modeling group (Study 5) will consult with TransCanada operations staff to define current unit loading and unloading procedures at the projects. Based on the defined procedures, the operations study group will provide several (approximately five) day-long time-series of sub-hourly flows to the hydraulic modeling group (Study 4).

2. The hydraulic modeling group will perform HEC-RAS model runs to determine the flow sequence at the downstream econodes, using as input the flow sequence that contains realistic sub-hour up-ramps and down-ramps. The results will define sub-hourly flow and elevation rate of change at each econode for each set of the test 24-hour-long flow sequences. The time-series of sub-hourly flows and elevations for each econode will be provided to the analysts involved with applicable erosion, fisheries and aquatics, and terrestrial studies.

3. The erosion, aquatics, and terrestrial study groups will review the sub-hourly flow and elevation rate of change for any issues and concerns. If there are concerns with the sub-hourly flow and/or elevation rate of change, recommendations for operational modifications to mitigate the concerns will be provided.

4. The operations study group will model the recommended changes with the Vista sub-hourly model (RT Vista) to assess the impact of these changes to TransCanada operations.

5. The resulting sub-hourly flows and elevations will also be provided to the erosion, aquatics, and terrestrial study groups to review and examine potential alternative operations changes that mitigate the original concern.

Completion of steps 4 and 5 depends on issues and concerns identified in step 3. Sub-hourly operation modeling will be conducted only if the erosion, aquatics, or terrestrial study groups have identified concerns with the sub-hourly econode flow and elevation from step 2.

ANALYSIS

Results from the operations model for various scenarios will be exported from the operations model for use in other studies.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

Vista DSS™ has become a standard in the water resource and power sector for operations analysis and simulation. This model is widely used by power companies for assisting in hydropower operations and for undertaking strategic studies. It has been implemented for many projects of North American power companies (e.g., Manitoba Hydro [5,000-megawatt], Bonneville Power Administration [20,000-megawatt], PacifiCorp, Tacoma Power, Southern California Edison, NextEra Energy, Nalcor Energy, and Saskpower), as well as projects for several international companies (Panama Canal Authority, Mighty River Power in New Zealand, and Volta River Authority in Ghana).

DELIVERABLES

The methods and results from the Hatch Vista DSS™ operations model, alternative scenarios, and database development will be summarized in a final report.

A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Study-related data will be made available to stakeholders upon written request, but the Vista DSS™ is proprietary; consequently, data input and output will be provided but not the actual model. HEC-RAS model input data files will also be provided upon written request.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

The Vista DSS™ operations model will be set up for the base operating conditions by the end of 2013. The integration of hydraulic parameters from Study 4 will occur in the first study year (2014). Refinements to the model will be made after study field work data (topographic and bathymetric surveys, river flow and water-level data collection) become available from preliminary field work or other studies. Model runs, additional model refinements, and additional model runs will be made during the second study year, as applicable.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for operations model setup and execution for the base operating condition and five alternative operations scenarios, including the addition of updated econodes and associated hydraulic parameters derived from Study 4 and aquatic habitat indices derived from Studies 7 and 9, is approximately $240,000. Assumed conditions and tasks follow:

- Assumptions:
  - 25 econodes; and
  - 5 scenarios for analysis.
- Tasks:
  - Derive rating curves for econodes and routing parameters for river reaches;
  - Enhance model functionality to handle complex index relationships;
  - Update operations model with econode locations and associated rating curves and routing parameters;
  - Re-run base case operations (five hydrologies) with updated model;
  - Establish reporting formats, in association with other study teams;
  - Analysis of new scenarios, as required, including report preparation according to agreed-upon formats;
  - Derive sub-hour ramp-up and ramp-down flow sequences at project sites;
  - If needed, complete one iteration of sub-hourly operations modeling; and
  - Attend three onsite meetings (six person-trips).

REFERENCES

NHFG (New Hampshire Fish and Game Department). 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Additional Technical References

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REVISED STUDY 6

WATER QUALITY MONITORING AND CONTINUOUS TEMPERATURE MONITORING

RELEVANT STUDY REQUESTS

FWS-20; NHDES-22a, -22b, -22c; NHDES-25a,-25b, -25c; NHFG-22a, -22b, -22c; NHFG-25a, -25b, -25c; VANR-02,-03b, 03c; CRWC-05, -06, -07, -08, -09, -10

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHFG, VANR, and CRWC stated that TransCanada should monitor water quality to determine the operational effects of the Wilder, Bellows Falls, and Vernon Projects on water quality.

The goal of this study is to determine potential project effects on water quality parameters of: dissolved oxygen (DO), water temperature, pH, turbidity, conductivity, nutrients, and chlorophyll-*a*. Documentation of these parameters will provide information on the effects of project operations on water quality over an extended period and during low-flow summer conditions. The water quality data collected will be compared to Vermont and New Hampshire water quality standards to help determine whether the projects are meeting state water quality standards.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS

- General goals for relicensing including ensuring that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives and conserving, protecting, and enhancing habitats for fish, wildlife, and plants affected by the projects.
- General goals related to aquatic resources including protection, enhancement, or restoration of aquatic and riparian habitats; and minimizing project effects on water quality and aquatic habitat.

NHDES

- State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.

NHFG

- General goals related to healthy ecosystems to support fish and wildlife. Goals reference New Hampshire Fish and Game

Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR

- State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat. The Connecticut River below Wilder dam is listed as impaired waters on the Section 303(d) due to flow alterations.

ASSOCIATION WITH OTHER STUDIES

This study is designed to be a stand-alone study. Water quality data collected in other aquatic resource studies will provide additional data points that may be included in the water quality dataset, as applicable. The results of this study will be used to inform the conclusions of other aquatic studies by documenting conditions that could influence behavior and distribution of biota, such as temperature, DO, and turbidity, and data on turbidity levels could also be used with the Riverbank Erosion Study (Study 3) to supplement project effects on erosion within project-affected areas.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Existing information is extensive and was cited and/or summarized in the project PADs. Specific to the TransCanada projects, after the upgrade of four of the generating units at the Vernon Project, NHDES issued a 401 Water Quality Certificate that required DO and temperature monitoring for the Vernon Project; sampling for this occurred in 2011 and 2012. In addition, TransCanada collected water quality data (temperature, specific conductivity, pH, DO, nutrients, and chlorophyll-*a*) in 2012 (Normandeau, 2013) in all three project areas from mid-June to mid-September as part of the 2012 Baseline Water Quality Study in accordance with a study plan that was reviewed and contributed to by NHDES and VANR. An additional water temperature dataset collected by Vermont Yankee, exists for the Vernon impoundment and tailrace (Normandeau, 2004).

Water quality data collected during the 2012 Baseline Water Quality Study are representative of conditions during a low-flow, warm-weather period. Obtaining an additional year of water quality data during a warm-weather period with more typical flows will better enable TransCanada to distinguish project effects from other factors that affect water quality. In addition, turbidity data and data from background monitoring stations upstream of the impoundments were not collected during the 2012 water quality sampling.

PROJECT NEXUS

The Wilder, Bellows Falls, and Vernon Projects impound 45, 26, and 26 miles, respectively, of the Connecticut River. The projects are operated primarily on a daily run-of-river basis, whereby over the course of a day, the projects pass the average daily inflow. Peaking often occurs during the course of the day, and the existing minimum flow requirements are 675, 1,083, and 1,250 cubic feet per second (cfs), respectively, although actual minimum flows are slightly higher to take advantage of generating unit efficiencies.

License-authorized operating limits for Wilder, Bellows Falls, and Vernon impoundments are 5, 3, and 8 feet, respectively; daily fluctuations, based on inflow and operations, vary between projects but are normally in the range of 2 to 3 feet. The impoundments and the operation of hydropower projects in general can affect water quality, especially temperature and DO. This study will provide information on how the project operations may affect water quality within the impoundments and tailraces. This study will supplement TransCanada's 2012 study results included in Normandeau (2013). The data obtained by this study will document whether the Connecticut River in the vicinity of the projects is in compliance with the water quality standards of both states.

STUDY AREA AND STUDY SITES

The study area will include the Wilder, Bellows Falls, and Vernon impoundments, as well as riverine locations upstream of the impoundments, the project tailraces, the Bellows Falls bypassed reach, and the mouths of key tributaries. The study will include the same 13 stations sampled during 2012, three additional background stations upstream of the influence of the three project impoundments, and at 10 tributary sites. Thus, the study area will extend from above the upstream limit of the Wilder impoundment (at approximately river mile [RM]265) to the tailwaters of the Vernon Project at the same station established during the 2012 sampling (V-TR). Station locations are described in Table 6-1, and Figure 6-1 depicts the approximate locations. Additional details regarding station locations will be included in a sampling and analysis plan that will be provided to NHDES and VANR for review and comment following FERC approval of the study plan and prior to study implementation.

Table 6-1. Summary of water quality station locations, 2014.

Station ID	Description	Latitude (decimal degrees)	Longitude (decimal degrees)	Approx. Depth at Station, if Known (feet)
W-04	Above the Wilder impoundment at about River Mile (RM) 265	44.12442	-72.04271	--
W-03	Wilder upper impoundment at RM 259.0	44.10057	-72.04336	7-9
W-02	Wilder mid-impoundment at RM 236.0	43.88204	-72.17256	24-26
W-01	Wilder forebay at RM 217.5	43.66877	-72.30223	44-46
W-TR	Wilder tailrace, below dam and powerhouse at RM 217.3	43.66618	-72.30520	--
BF-04	Above the Bellows Falls impoundment at about RM 202.3	43.47513	-72.38240	--

Station ID	Description	Latitude (decimal degrees)	Longitude (decimal degrees)	Approx. Depth at Station, if Known (feet)
BF-03	Bellow Falls upper-impoundment at RM 194.5	43.45599	-72.39025	9-11
BF-02	Bellows Falls mid-impoundment at RM 184.4	43.29502	-72.40262	10-12
BF-01	Bellows Falls forebay at RM 173.8	43.13808	-72.44861	40-42
BF-BR	Bellows Falls bypass reach, approximately 2,100 feet below the dam in the bypassed reach	43.13620	-72.44040	--
BF-TR	Bellow Falls tailrace, below dam and powerhouse at RM 172.9	43.13156	-72.44179	--
V-04	Above Vernon impoundment at about RM 171.6	43.08745	-72.43449	--
V-03	Vernon upper impoundment at RM 167.4	43.07041	-72.44458	7-9
V-02	Vernon mid-impoundment at RM 154.1	42.92997	-72.52601	15-17
V-01	Vernon forebay at RM 142.0	42.77271	-72.51082	52-54
V-TR	Vernon tailrace, below dam and powerhouse at RM 141.8	42.76932	72.51408	--

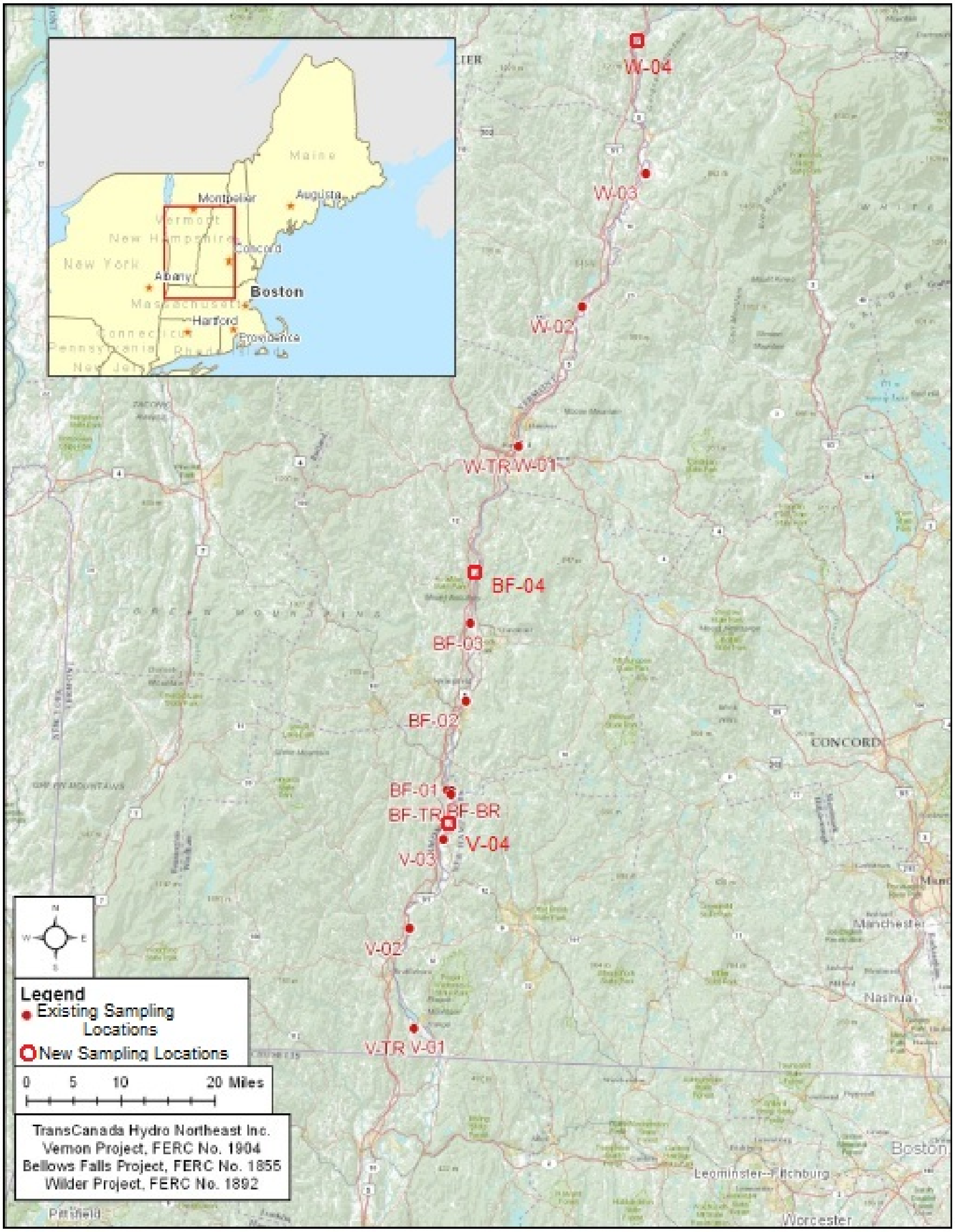

Figure 6-1. Locations of Connecticut River mainstem water quality monitoring stations, 2014.

Continuous water temperature monitoring at 15-minute intervals will be conducted at the mouths of the following 10 major tributaries to the Connecticut River: Waits, Ompompanoosuc, Mascoma, White, Sugar, Black, Williams, Cold, Saxtons, and West rivers. Monitoring sites will be located such that the data are representative of the water temperature of the tributary inflow to the Connecticut River, but the exact locations will be located in the field as determined by access and the ability to capture representative water temperature of the tributary inflow. Continuous water temperature monitoring will also occur at the 16 mainstem Connecticut River sites and at a transect in the Vernon forebay area. In addition, this study will include continuous water temperature monitoring at transects at the monitoring locations within the impoundments during the 10-day, low-flow period.

METHODS

The methodology for weekly impoundment vertical profiles, weekly impoundment nutrient and chlorophyll-*a* samples, and continuous (15-minute interval) datasondes for temperature, DO, specific conductivity, pH and turbidity in the project impoundments and tailraces will be similar as those used in the 2012 sampling program (Normandeau, 2013). Because of the geographic extent of the study area, it will not be feasible to conduct the weekly profiles in the three impoundments on the same day, but with conditions permitting, the profiles will be conducted within 3 consecutive days of each sampling week. In addition, turbidity probes will be added to each of the mainstem Connecticut River multi-parameter datasondes.

From the first week of April (conditions permitting) through November 15 (conditions permitting), tributary data loggers will continuously monitor water temperature only. During this same period, continuous monitoring of water temperature will occur at the 16 mainstem water quality stations and at the Vernon Project forebay. At each of the four datasonde monitoring locations above or in the three impoundments, at least 10 days of data will be collected at 15-minute increments during a period of low flow (<3 x 7Q10) and high temperatures (preferably over 23^{o}C) between June 1 and September 30.

At the datasonde monitoring locations in the impoundments during the 10-day, low-flow, and high-temperature period, transects will be established for additional water temperature data collection. These transects will consist of three stations (including the mid-channel, long-term datasonde) perpendicular to the flow with the water temperature data loggers at depths of 1 meter, mid-depth, and 1 meter from the bottom recording at least 10 days of data at 15-minute intervals. In addition, a transect will be established at the Vernon Project forebay with up to five stations with water temperature data loggers set at depths of 1 meter below the water surface, mid-depth, and 1 meter from the bottom to continuously record data from April 1 through November 15, conditions permitting.

Flow in the Bellow Falls bypassed reach during water quality monitoring will be determined by calculation when spillage is occurring, and by stage/discharge relationships when only leakage is occurring. Details of bypassed reach flow determinations will be provided in a sampling and analysis plan that will be provided to NHDES and VANR for review and comment following FERC approval of the study plan and prior to study implementation.

YSI 6920 V2 multiple-parameter water quality sondes will be used as in the 2012 study. A vertical dissolved oxygen and water temperature profile will be conducted prior to deployment of the datasondes measuring dissolved oxygen and temperature at W-04, W-03, W-02, W-01, W-TR, BF-04, BF-03, BF-02, BF-01, BF-BR, BF-TR, V-04, V-03, V-02, V-01, and V-TR. The datasondes will then be deployed at the bottom of the epilimnion (if stratified) or at 25% depth if not stratified. The continuous monitors will be maintained, calibrated, and data-downloaded on a weekly basis during the monitoring period, conditions permitting, but no more than biweekly. This interval should be suitable for waters of relative high quality as found in this portion of the Connecticut River.

Onset HOBO Water Temperature Pro v2 data loggers or the equivalent will be used to record water temperatures at the 10 sites within the tributaries and the 9 mainstem Connecticut River stations not occupied by multi-parameter data loggers. Data will be downloaded from the water temperature data loggers generally on a weekly basis, conditions permitting, but at no greater than biweekly intervals. Actual download frequency will be based on factors, such as flows, study schedules, weather conditions, and crew safety. All sampling locations will be located and re-occupied by handheld GPS unit with a 10-foot horizontal level of accuracy. Table 6-2 provides a summary of the water quality monitoring that will occur at each location and the sampling frequency and duration.

Table 6-2. Summary of water quality parameters, frequency, and duration to be monitored at each sampling location, 2014.

Task	Locations	Description	Sampling Frequency	Start Date	End Date
Continuous monitoring with multi-parameter datasondes	W-01, W-TR, BF-01, BF-BR, BF-TR, V-01, and V-TR	Monitoring of DO, temperature, conductivity, turbidity, and pH via deployed datasonde with automatic logging	15 min.	June 1	Sept. 30
Continuous monitoring with multi-parameter datasondes	W-02, W-03, W-04, BF-04, BF-03, BF-02, V-04, V-03, and V-02	Monitoring of DO, temperature, conductivity, turbidity, and pH via deployed datasonde with automatic logging	15 min.	A 10-day, low-flow period between June 1 and Sept. 30	NA

Task	Locations	Description	Sampling Frequency	Start Date	End Date
Instantaneous monitoring with multi-parameter datasondes	W-04, W-03, W-02, W-01, W-TR, BF-04, BF-03, BF-02, BF-01, BF-BR, BF-TR, V-04, V-03, V-02, V-01, and V-TR	Monitoring of DO, temperature, conductivity, turbidity, and pH via mobile datasonde. Measurements taken at 1 meter increments from the water surface to channel bottom	Weekly	June 1	Sept. 30
Water sample collection and laboratory analysis	W-01, BF-01, and V-01	Water samples collected as water column core from water surface to channel bottom. Laboratory analysis of nitrate/nitrite, total nitrogen, total phosphorus, total Kjeldahl nitrogen, and chlorophyll-*a*	Weekly	June 1	Sept. 30
Water temperature continuous monitoring	10 tributaries	Monitoring of water temperature with deployed data logger	15 min.	April 1 (or as soon thereafter as safe to deploy units)	Nov. 15 (unless unsafe conditions are expected to preclude data collection)
Water temperature continuous monitoring	W-04, W-03, W-02, W-01, W-TR, BF-04, BF-03, BF-02, BF-01, BF-BR, BF-TR, V-04, V-03, V-02, V-01, and V-TR	Monitoring of water temperature with deployed data logger, when station not occupied by multiparameter datasonde	15 min.	April 1 (or as soon thereafter as safe to deploy units)	Nov 15 (unless unsafe conditions are expected to preclude data collection)

Task	Locations	Description	Sampling Frequency	Start Date	End Date
Water temperature continuous transect monitoring	W-04, W-03, W-02, W-01, BF-04, BF-03, BF-02, BF-01, V-04, V-03, and V-02	Monitoring of temperature via deployed data logger with automatic logging. Measurements taken at three stations (including the mid-channel long-term datasonde) perpendicular to the flow. At each station a data logger will be placed at 1 meter below the surface, mid-depth, and 1 meter above the bottom at the three transect locations	15 min.	A 10-day, low-flow period between June 1 and Sept. 30	NA
Water temperature continuous transect monitoring at Vernon forebay	V-01	Monitoring of temperature via deployed data loggers. Measurements taken at the surface, mid-depth, and near bottom at three to five transect locations	15 min.	April 1 (or as soon thereafter as safe to deploy units)	Nov. 15 (unless unsafe conditions are expected to preclude data collection)

Quality Assurance and Quality Control Procedures and Objectives

The inspection, testing, and maintenance of multi-parameter datasondes and data loggers will be performed in accordance with manufacturer recommendations and the schedule provided in Table 6-3. Datasondes and data loggers deployed for continuous monitoring will be inspected for possible debris or fouling, cleaned as necessary prior to use or reuse, and tested through the Quality Control (QC) process outlined in Table 6-4. The condition of the sensors upon retrieval and deployment will be noted on the field data sheets. The water temperature data loggers have an accuracy of +/-0.2 °C in the 0° to 50°C range. Although the accuracy and reliability of these temperature units is quite high, temperature readings of the individual temperature data loggers will be checked upon deployment and afterwards on a monthly basis by the use of a National Institute of Standards and Technology-certified thermometer.

The Field Monitoring Team Leader will be responsible for inspecting, testing, and maintaining field instruments for this project as summarized in Tables 6-3 and 6-4. The Field Monitoring Team Leader will obtain spare parts and supplies for the datasondes and will review field notes from previous sampling events to ensure that any previous equipment problems have been identified and that all necessary repairs have been made.

Table 6-3. Summary of water quality instrument/equipment maintenance, testing, and inspection, 2014.

Equipment Name	Activity	Frequency of Activity	Acceptance Criteria	Corrective Action	Person Responsible
Multi-parameter datasonde (YSI 6920)	Maintenance and inspection (cleaning) and testing (operation)	Weekly, when conditions allow but no longer than bi-weekly	Visible cleanliness; normal operation	Repeat cleaning. If repeat cleaning does not correct the problem, use alternate data logger.	Field Monitoring Team Leader
Onset HOBO Water Temperature Pro v2 data loggers	Maintenance and inspection (cleaning) and testing (operation)	Monthly	Visible cleanliness; normal operation	Repeat cleaning. If repeat cleaning does not correct the problem, use alternate data logger.	Field Monitoring Team Leader

Instrument Calibration and Frequency

The multi-parameter datasondes will be calibrated and tested as per manufacturer recommendations and outlined in Table 6-4 prior to use. At the continuous monitoring stations, the sondes will be tested and calibrated prior to the initial deployment and downloaded and checked about halfway through the 10-day, low-flow period as well as at the end of the 10-day, low-flow period. During the weekly recurring sampling events, the sonde will be tested and calibrated at the start of the sampling day and will be tested and calibrated again at the end of the sampling day.

All calibration data will be documented on field data sheets. When necessary, the batteries in the field instruments will be changed prior to calibration and redeployment of the instrument. The field crew will note on the field data sheet when batteries are changed.

Table 6-4. Water quality instrument calibration and frequency, 2014.

Instrument/Equipment	Calibration Method	Calibration Frequency
Water temperature	Default factory calibration	Check calibration upon deployment and afterward on a monthly basis by the use of a National Institute of Standards and Technology-certified thermometer.
Dissolved oxygen	Saturated air method	Calibrate at start of sampling day (weekly profiles) or at time of data download (continuous monitors). Check calibration at end of sampling day (weekly profiles) and as needed.
Specific conductivity	One point calibration method	Calibrate at start of sampling day (weekly profiles) or at time of data download (continuous monitors). Check calibration at end of sampling day (weekly profiles) and as needed.
pH	Two point calibration method	Calibrate at start of sampling day (weekly profiles) or at time of data download (continuous monitors). Check calibration at end of sampling day (weekly profiles) and as needed.
Depth	One point calibration method	Calibrate prior to vertical profile or deployment.
Turbidity	Two point calibration method	Check calibration on a monthly basis with zero nephelometric turbidity unit (NTU) and 126 NTU solutions.

Additional details regarding QA/QC will be included in a sampling and analysis plan that will be provided to NHDES and VANR (state Clean Water Act Section 401 Water Quality Certification agencies) for review and comment following FERC approval of the study plan and prior to study implementation.

ANALYSIS

Water quality results from this study, as well as incidental data collected during other aquatic studies, will be graphically compared to both state water quality standards and project operations, including hourly generation, impoundment elevation, discharge and associated water-level changes in riverine reaches, and daily weather conditions at nearby National Oceanic and Atmospheric Administration (NOAA) weather stations during the study period, and will be compared to historical average daily weather conditions. In addition, the average daily flows at the West Lebanon and Walpole USGS gages during the April to November 15 period as compared to the average daily values for the 1972 to 2012 period will be provided. The water quality results from this study will also be compared to water quality data gathered in 2012 (Normandeau, 2013) to contrast weather and flow conditions between the two sets of water quality data. The information acquired will be used to qualify and quantify water quality data for the Connecticut River, including background and tributary inflows, and identify project operations that may affect water quality. The possible effects of different flow and weather conditions during the different days that the weekly reservoir profiles are conducted will also be analyzed.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

This study involves collecting water quality data using methods and equipment generally accepted by the scientific community.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. The report will present the results of the 2014 water quality monitoring program and compare the results with the 2012 water quality monitoring study (Normandeau, 2013). As requested, water quality data will be provided to the NHDES in an Excel format similar to that provided in 2009 for the 2008 water quality monitoring at TransCanada's Fifteen Mile Falls Project (FERC No. 2077) or in a mutually agreed upon format suitable for uploading to NHDES' Environmental Monitoring Database.

A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

Water quality sampling specific to this study will occur in the first study year (2014). The study will commence the first week in April or as soon as safe to deploy temperature monitors, and will continue through November 15 or sooner if it becomes unsafe to collect additional data. The exact start and end dates will depend on safe conditions for unit deployment and retrieval. Schedules for water quality monitoring associated with other studies will be as described in those study plans.

LEVEL OF EFFORT AND COST

The preliminary estimated cost of this study is $280,000 for this 1-year monitoring program.

REFERENCES

NHFG (New Hampshire Fish and Game Department). 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Normandeau (Normandeau Associates, Inc.). 2013. 2012 Baseline Water Quality Study. Wilder Hydroelectric Project No. 1892, Bellows Falls Hydroelectric Project No. 1855, Vernon Hydroelectric Project No. 1904. Agency Draft Report. Prepared for TransCanada Hydro Northeast, Inc. February 8, 2013.

Normandeau. 2004. §316(a) Demonstration in Support of a Request for Increased Discharge Temperature Limits at Vermont Yankee Nuclear Power Station during May through October. Prepared for Entergy Nuclear Vermont Yankee, LLC, Vernon, VT.

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REVISED STUDY 7

AQUATIC HABITAT MAPPING

RELEVANT STUDY REQUESTS

FERC-05

STUDY GOALS AND OBJECTIVES

In its study request, FERC identified issues related to potential effects on fish and aquatic resources from operations of the Wilder, Bellows Falls, and Vernon projects. Specifically, low-flow conditions and low impoundment water levels at certain times may affect the ability of fish and other aquatic species to use aquatic habitats.

The goal of this study is to survey, identify, and map aquatic habitat at the Wilder, Bellows Falls, and Vernon Project-affected areas and assess potential effects under current operations.

The objectives of this study are to:

- survey and map the aquatic habitat types distributed within the project impoundments, tailwaters, and downstream riverine corridors from the upper extent of the Wilder impoundment and downstream to Vernon dam, including the Bellows Falls bypassed reach and the tailwater just below Vernon dam; and

- describe potential influences of project impoundments and project operations on the distribution of aquatic habitat within the reaches to be assessed.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

Because only FERC requested this study, there are no relevant resource management goals of agencies or Indian tribes with jurisdiction over the subject resources that directly apply to this study. However, because this study will inform numerous other studies as described below, resource management goals listed in the associated study plans can be considered relevant to this study.

ASSOCIATION WITH OTHER STUDIES

Aspects of several other studies depend on information gathered from this aquatic habitat mapping study. For all studies listed below, acquisition of aquatic habitat mapping data will need to be completed prior to commencement of these interdependent studies.

- Instream Flow Study (Study 9) will use the results of this study to assist with study site and transect selection and, to some extent, the proposed study method (i.e., 1-D, 2-D, Demonstration Flow Assessment).

- Resident Fish Spawning in Riverine Sections Study (Study 15) will use habitat types, depth, and substrate information derived from this study to locate suitable spawning habitat and assess project effects.

- Tributary and Backwater Area Fish Access and Habitats Study (Study 13) will use aquatic habitat data and bathymetry information collected during impoundment mapping as part of its assessment.

- Aquatic habitat data will be used in the analysis of distribution of resident riverine and diadromous fish species within project-affected areas (Studies 10, 11, and 12).

- Floodplain, Wetland, Riparian, and Littoral Habitats Study (Study 27) will use aquatic habitat and bathymetric data to define the littoral zone, quantify the effects of water-level changes on wetland and littoral vegetation communities, and quantify suitable habitat for aquatic vegetation.

- Hydraulic Modeling Study (Study 4) and Operations Modeling Study (Study 5) will rely on the results of this study for modeling purposes, and these models will determine the association and effect of project operations on conditions observed at specific locations within the impoundments and downstream affected areas. These tools are critical for evaluating and determining potential influences of project operations on the distribution of aquatic habitat within the reaches to be assessed. They will also be critical to assessing project-related association and effects within the above-mentioned associated studies as well as numerous other studies.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Minimal information exists pertaining to characteristics, types, and proportions of aquatic habitat within the project impoundments, tailwaters, and riverine reaches. Yoder et al. (2009) conducted a localized, qualitative habitat evaluation in a few selected sites in conjunction with the assessment of fish assemblage in the mainstem Connecticut River. Specific aquatic habitat data within all project reaches are lacking, and this study will serve to fill those data gaps

PROJECT NEXUS

Currently, water levels in the impoundments, tailwaters, and downstream riverine areas fluctuate due, in part, to the daily operations of all three projects. In addition, there is no minimum flow requirement in the Bellows Falls bypassed reach. As a result, aquatic habitats may be exposed under low-flow conditions, and low impoundment water levels may be adversely affected and/or not used by aquatic species during various life stages. Changes in flow or periods of low flow may also cause stranding and associated mortality of fish or other aquatic species (e.g., mussels and macroinvertebrates).

This study will help establish a baseline condition of aquatic habitats in the Connecticut River from the head of the Wilder impoundment to Vernon dam under current licensed project operations.

STUDY AREA AND STUDY SITES

The study area includes all project impoundments and riverine sections of the Connecticut River from the Wilder Project to downstream of Vernon dam. Impoundment sections include from Wilder dam upstream 45 miles, from Bellows Falls dam upstream 26 miles, and from Vernon dam upstream 26 miles. Riverine reaches consist of a 17-mile-long segment downstream of Wilder dam, a 6-mile-long segment downstream of Bellows Falls dam, and an approximate 1.5-mile-long segment downstream of Vernon dam to the downstream extent of Stebbins Island. In addition, the 3,500-foot-long Bellows Falls bypassed reach will be mapped.

METHODS

Aquatic habitat differs between lotic (flowing water) and lentic (standing water) ecosystems. As a result, the aquatic habitat mapping process and types of habitat identified differ. Bathymetric and habitat mapping of the lentic impoundment sections are anticipated to begin in the spring\summer of 2013. It is TransCanada's intent to conduct the bathymetric and habitat mapping of the three project impoundments with water levels at or near full pond elevations, as feasible based on 2013 water-level conditions. TransCanada relicensing staff will consult with operations staff and work toward achieving these conditions to the extent allowable. Mapping of lotic riverine reaches will take place during the minimum flow or lowest flow available at the time of the survey. Mapping the lotic riverine reaches during these conditions will allow for the determination and mapping of the entire transition area from riverine to impounded habitat. As with the bathymetric and habitat mapping of the project impoundments, operations staff will be consulted to work toward achieving these conditions to the extent allowable. In addition to bathymetric and habitat mapping, information on changes in water surface elevations in selected mainstem, setback, and tributary mouth locations will be collected using Onset HOBO water-level data loggers.

Impoundment Aquatic Habitat and Bathymetry Survey Methods

Impoundment habitat data will be collected using a side scan sonar system (Humminbird® 1197c, Side Imaging system). Impoundment bathymetric data will be collected using a 200-kilohertz (kHz) Odom® Hydrotrac single-beam echosounder (<0.03-foot (~0.01-meter) vertical accuracy). This echosounder will be calibrated on a daily basis using the industry standard bar check method. Collection of habitat and bathymetric data in the impoundments will use a Real Time Kinematic (RTK) unit (Leica® Viva GS14) for positional information. The RTK unit has a horizontal positional accuracy of less than 0.03 inch (0.01 meter) and will provide vertical water surface positional information at an accuracy of less than 0.1 foot (0.02 to 0.03 meter) to compensate for fluctuations in water levels as well as differentials in water surface elevations within each impoundment. This allows the bathymetry survey to output river bed surface elevations by calculating the difference of the elevation of the survey vessel and the water depth while the survey is in progress. The RTK unit also provides horizontal positional information necessary for geo-referencing the side scan images collected for the assessment of impoundment habitat data.

Bathymetry and habitat data will be collected along pre-determined survey lines and can be collected concurrently in the central portions of the impoundments where the equipment used will operate on separate frequencies that do not interfere with each another. Bathymetry and habitat data will be collected separately along the shorelines of the impoundments to avoid interference between the collection of bathymetric data by the Odom echosounder and the 800-kHz side scan sonar frequency. Collection of shoreline impoundment habitat data using the side scan sonar data will occur only when the impoundment is within normal elevation range to ensure complete coverage of the shoreline habitat. Bathymetry data will be collected at a 2-foot-interval scale in the center of the impoundments, and at a 1-foot-interval scale in shoreline, backwater, island and shoal areas where boats have access, which will provide sufficient detail to assess the potential effects of reservoir fluctuations on aquatic habitat. The locations and depths of 1-foot contours will vary due to the slope of the banks.

Portions of the Wilder, Bellows Falls, and Vernon impoundments will not be able to be mapped using side scan sonar due to shallow water depths, turbulence (i.e., near rapids or falls), or dense beds of aquatic vegetation. In very shallow areas (less than approximately 18 inches deep), the survey boat is unable to collect bathymetry or habitat data, and these areas will be mapped manually using GPS to create polygons around the different habitat types. Water depths will also be collected in these areas manually using GPS, an RTK unit, and a stadia rod at selected transects. The manually collected data will be merged into the habitat and bathymetry shape files upon completion of the field work. Results from sections of the impoundments that are not accessible for quantification by side scan sonar will be presented in geo-referenced substrate classifications conducted using a technique appropriate for the conditions (e.g., view tube, ponar grab, and wading). Those observations will be imported into GIS and used in conjunction with results of the side scan surveys.

Impoundment Habitat Data Processing

Accurate side scan track data will be imported into GIS and used to reference the sonar imagery to its place on the river bottom. The imported imagery will be used to create a GIS shapefile in PNG format with 2- to 4-inch resolution. The resulting shapefile will be subjected to visual quality control inspection for positional accuracy and image quality. When sufficient images are present to provide coverage of the impoundments, dominant habitat types will be delineated, resulting in a 2-D representation of the riverbed divided into habitat types. A total of six substrate types will be identified based on the dominant habitat type: 1) sand/silt/clay, 2) gravel/cobble, 3) boulder, 4) riprap, 5) ledge, and 6) woody debris. Given the resolution provided by this technique, it is not possible to differentiate substrate types finer than gravel, and as a result, sand, silt, and clay will be grouped into a single class. Likewise, gravel and cobble will also be classified as a single category because the particle sizes cannot be differentiated in some cases. Habitat types will be delimited down to a minimum map unit of 100 square feet (0.002 acre). However, in most cases, habitats smaller than this area will be discernible and included in the substrate dataset. The final product of this process will be a GIS shapefile containing the aquatic habitat types for each of the three project impoundments.

Classifications of all habitat types from side scan imagery will be validated while in the field. Validation of substrate classifications will consist of visual assessment using a view tube within shallow-water habitats and/or clear water conditions. A copper pole or chain drag technique will be used to validate substrate classifications in randomly selected, deep-water habitats and locations having poor visibility during sampling. These techniques rely on the resonance associated with the hardness and size of different substrate types as they come into contact with the metal probe. Ponar grab samples may also be employed for validating substrate classifications in deeper water areas. Each of these validations will have a recorded position associated with them and will be used as a quality control check for comparison to the final side scan impoundment habitat product.

Impoundment Bathymetric Data Processing

Bathymetric data will be imported into GIS, and positional data will be audited for outliers. The upper elevation of the operational range for each impoundment will be digitized based on available digital orthophotos and verified through the use of field observations during periods when inflows approach station capacity and/or during scheduled periods when impoundments are full. Using GIS, bathymetric data points will be spatially subsampled and interpolated to create a three-dimensional (3-D) surface. The resulting surface will be verified by field observations and aerial photography. The 3-D surfaces generated for each impoundment will be converted to a series of 2-foot bathymetric contours with 1-foot bathymetric contours in the littoral portions of the impoundments.

Bathymetric data collected in each of the project impoundments will be subjected to the standardized guidelines and requirements for processing and generating deliverables for the NOAA Office of Coastal Survey hydrographic surveys (NOAA, 2013). As part of this quality control process, the accuracy of soundings will be validated by checking the observed depth with a calibrated sounding pole or lead line deployed alongside the echosounder. In addition to field confirmation of soundings, the recorded depths at the intersections of crossing survey transects will be evaluated for differences using the cross check module of Hypack survey software. The observed differences in replicate depth readings will be summarized, and the accuracy of the survey methods used to generate project bathymetry in the Wilder, Bellows Falls, and Vernon impoundments will be included in the study report.

Riverine Aquatic Habitat Methods

Riverine habitat mapping will be performed drifting downstream in a small johnboat equipped with oars and a small outboard motor, or by canoe if boat access is limited or difficult. A depth transducer mounted to the side of the boat and a

Trimble GPS unit attached to an onboard laptop computer or data logger will be used to continually monitor depth and record real-time GPS positions. The GPS will also be used to record habitat boundaries and any other features, such as islands, split channels, and tributaries. In addition, a hand-held GPS unit will record habitat unit boundaries as a backup. In shallow areas, the survey will generally follow the thalweg (deepest part of the channel). In long pools and runs, the survey crew will attempt to locate the deepest portion of the channel. In instances of islands or split channels, the primary channel will be mapped, and a visual examination will be performed on the secondary channel to determine habitat type correspondence between the two channels. If differences are noted, the other channel will also be mapped. The Bellows Falls bypassed reach will be mapped on foot.

Riverine habitat types are often referred to as mesohabitats. Generally, the three major mesohabitat types recognized are pool, run, and riffle, although these types are often broken down into sub-types depending on the river channel morphology. Unless a specific type of habitat is considered important for a given aquatic species, the actual habitat types are not as critical as being consistent in identifying those types in the field. For this study, the mesohabitat types expected to be used are:

- pool — deep, low velocity with a generally well-defined control and retains water at zero discharge;
- glide — shallow with moderate velocity distributed across the channel without a well-defined thalweg; sometimes referred to as shallow pool if velocities are low;
- run — deep to moderately deep with fast velocity in a well-defined thalweg, surface may be turbulent, and substrate variable;
- riffle — shallow with gravel, cobble, or boulder substrate, fast water with turbulent flow or white-water, and possible exposed substrate;
- rapid — shallow bedrock, boulder with turbulent white-water flow and possible exposed substrate; may be brief and abrupt across the stream channel or extend for a greater distance; and
- other — may include backwaters or other mesohabitat types if primary types are believed to be insufficient for characterization; the mapping protocol will allow for additional types or sub-types to be added according to the best judgment of the field personnel.

Pool and run habitat may be broken down further into deep and shallow depending on results of depth distributions derived from mapping results. Additional information that will be collected for each mesohabitat unit includes dominant and subdominant substrate and bank or instream cover type (e.g., ledges, boulders, and vegetation). Substrate will be classified into: 1) organics, 2) silt and clay, 3) sand, 4) gravel, 5) cobble, 6) boulder, and 7) bedrock.

Water Surface Elevation Monitoring

Onset Hobo water-level data loggers (vertical accuracy of +/- 0.1 inch) will be installed at selected locations over the entire length of the study area. Information collected from these data loggers will include water depth and 15-minute continuous temperature readings. Water-level and temperature monitoring will be conducted in project-affected areas during the summer/fall of 2013. Data loggers will be removed when the first phase of this study is complete in 2013. In 2014, data loggers will be re-deployed and moved to particular sites of interest for various resource studies (e.g., spawning sites, backwater and tributary sites, erosion sites, and sites needed for the two modeling studies [Studies 4 and 5]). The timing of data logger deployment and the duration of monitoring will be dependent on the needs of those resource studies, and the placement of these loggers is likely to be in shallow water that makes them vulnerable to winter ice conditions.

Data collected will be used to describe potential influences of project impoundments and project operations on available aquatic habitat as well as other natural resources. Loggers will be installed at pre-determined locations (Table 7-1 and Figures 7-1 through 7-7) and their positions will be geo-referenced using RTK positional information so that their exact elevation is known relative to the specific project operational water levels (e.g., full pond). Proposed locations were selected to provide data for one or more of the following objectives:

- hydraulic modeling (HEC-RAS) simulating river flow through impoundments and river reaches (Study 4);
- assessment of project-related erosion (Studies 1, 2, and 3);
- assessment of changes in water surface elevations associated with project operations on setback habitat;
- assessment of changes in water surface elevations associated with project operations on tributary confluence area habitat; and
- data collection of air barometric pressure required for the post-processing calculation of data logger water depths

The level logger locations in Table 7-1 and Figures 7-1 through 7-7 include 84 sites and are proposed locations. TransCanada encourages applicable working groups to provide input into additional or alternative locations for data collection.

Table 7-1. Purpose and location of data loggers.

Number	Purpose	Comments	Project Area	Latitude	Longitude
1	HEC-RAS/ Erosion	Top of Wilder Haverhill, NH	Wilder	44.10260879430	-72.03542926400
2	HEC-RAS	Near Bridge	Wilder	44.06639015720	-72.05021696570
3	Tributary	Haverhill, NH; Oliverian Brook	Wilder	44.04815931570	-72.06327558040
4	HEC-RAS/ Erosion	Near Old Bedell bridge site	Wilder	44.04588760180	-72.07415798280
5	HEC-RAS/ Erosion	South of Haverhill, NH	Wilder	44.01411887580	-72.09746704820
6	Setback	E Side, South of Haverhill, NH	Wilder	44.00955123000	-72.09081311620
7	Setback	Bradford, VT, Waits River	Wilder	43.99498201270	-72.11888144290
8	Barometer	Near Small Oxbow Setback sensor in Piermont, Northern Wilder Barometer	Wilder	43.97112590820	-72.10607079840
9	Setback	E side, Small Oxbow, Piermont, NH	Wilder	43.97140654250	-72.10565999050
10	Tributary	E side, Piermont, NH	Wilder	43.96768658890	-72.09023385460
11	HEC-RAS/ Erosion	Piermont, NH Just US of a constriction	Wilder	43.95936655130	-72.09927959420
12	HEC-RAS/ Erosion	just DS of a Constriction; Orford	Wilder	43.92661865250	-72.11777763330
13	Setback	East side, North of Orford, NH	Wilder	43.91302120400	-72.12758156400
14	HEC-RAS/ Erosion	North of Orford, NH	Wilder	43.89504344280	-72.15535480410
15	Setback	West side, South of Fairlee, VT	Wilder	43.88850178520	-72.16739115060
16	Setback	West side, North Thetford BR	Wilder	43.84134166320	-72.18383619370
17	Erosion/ HEC-RAS	Property:River Rd at Lyme, S of N Thetford rd	Wilder	43.84017032880	-72.18319745750
18	Erosion/ HEC-RAS	Mudge Property	Wilder	43.82395249770	-72.18645006630

Number	Purpose	Comments	Project Area	Latitude	Longitude
19	Erosion/ HEC-RAS	Between McIntyre and other property 1/4mi south of E Thetford Br	Wilder	43.80015426180	-72.19127826530
20	Setback	DS of Mudge Property and Grant brook	Wilder	43.79471061420	-72.19111520450
21	Setback/ Tributary	Hewes Brook	Wilder	43.78583790230	-72.20039135670
22	Barometer	Near Hewes Brook Trib, Southern Wilder Barometer	Wilder	43.78587607650	-72.20220505080
23	Setback	Ompompanoosic west of 91	Wilder	43.76021944340	-72.23315863160
24	HEC-RAS	E side opposite Ompompanoosic	Wilder	43.74765937040	-72.22972856320
25	Setback	West side below Ompompanoosic	Wilder	43.74610015700	-72.23481944480
26	Erosion/ HEC-RAS	Pine Park, Dartmouth campus	Wilder	43.71586419490	-72.28876019900
27	Setback	Bloody brook 2, west side	Wilder	43.70244639260	-72.30336208670
28	Setback	Mink Brook, east Side	Wilder	43.69642399200	-72.29671334230
29	HEC-RAS	Near Mascoma Floodplain	Wilder Riverine	43.60677038610	-72.32706349800
30	Tributary	Bloods brook, Large Sandbar	Wilder Riverine	43.60618910040	-72.32654315330
32	HEC-RAS	Mainstem, paired with Sm backwater west side hobo	Wilder Riverine	43.58450950730	-72.35478245340
33	Setback	West side	Wilder Riverine	43.52017283100	-72.39619989780
34	Barometer	Near Bellows Riverine Setback	Wilder Riverine	43.52017979530	-72.39636468640
35	Setback/ HEC-RAS	Mainstem, paired with west side hobo	Wilder Riverine	43.51885555690	-72.39475465870
36	Tributary	Blow-me-down brook, delta	Wilder Riverine	43.49409601060	-72.37892388410
37	Tributary	Mill Brook 4, West side, impacted upstream?	Wilder Riverine	43.47266340970	-72.38665306660

Number	Purpose	Comments	Project Area	Latitude	Longitude
38	Tributary	Mill Brook 3, East side, Sand Bar	Wilder Riverine	43.47046311490	-72.38586226830
39	Erosion/ HEC-RAS	Lipfert Property, top of impoundment	Bellows	43.43466695190	-72.39399754090
40	Tributary	Mill Brook 2, Sand bar	Bellows	43.40159890220	-72.40210864210
41	HEC-RAS/Erosion/Trib	Above constriction and near Erosion sites and Tributary	Bellows	43.39654898410	-72.40060177800
42	Tributary	Barkmill Brook, Sand bar	Bellows	43.36200299700	-72.41210624590
43	HEC-RAS/ Tributary	Near Little Sugar R	Bellows	43.30801768270	-72.39930861350
44	Barometer	Near L. Sugar River Trib sensor	Bellows	43.30618997680	-72.39686333780
45	Tributary	Little Sugar River Sand Bar	Bellows	43.30735169990	-72.39562440010
46	Setback	Black River mouth	Bellows	43.26227503980	-72.42999736670
48	Setback	West side Great Meadow	Bellows	43.19368514030	-72.45100682260
49	HEC-RAS/ Erosion	US of Williams River	Bellows	43.19209588900	-72.44448340010
50	Setback	Herricks Cove	Bellows	43.18109485060	-72.44728992120
51	Setback	East Side Behind RR	Bellows	43.15268946580	-72.45709591410
52	Tributary	Saxtons River Gravel bar	Bellows Riverine	43.12437475560	-72.43828094680
53	HEC-RAS/Tributary	1 mile south of Bellows dam near tribs	Bellows Riverine	43.11952849290	-72.43123574850
54	Barometer	Cold River	Bellows Riverine	43.11877409330	-72.43070735180
55	Tributary	Cold River Gravel Bar	Bellows Riverine	43.11909694110	-72.43006709700
56	HEC-RAS/ Tributary	Near Cobb Brook	Bellows Riverine	43.09481563210	-72.43888193240
57	Tributary	Cobb Brook Braided bar	Bellows Riverine	43.09434266170	-72.43905332760
58	Tributary	Great Brook Gravel bar	Vernon	43.04115367340	-72.45755565070

Number	Purpose	Comments	Project Area	Latitude	Longitude
59	Tributary	Mill Brook 1, Big Gravel bar at mouth	Vernon	42.99883069910	-72.45439273170
60	HEC-RAS/ Erosion	Near E Putney Brook	Vernon	42.98656923900	-72.46446128940
61	Tributary	East Putney Brook Gravel Bar at mouth	Vernon	42.98587572410	-72.46427673420
62	Tributary	Canoe Brook Gravel bar at mouth	Vernon	42.94617316880	-72.53168390620
63	Tributary	Catsbane brook	Vernon	42.91045881690	-72.52542312130
64	Barometer	Near Catsbane Brook trib sensor	Vernon	42.91105191130	-72.52614742570
65	HEC-RAS	US of West river	Vernon	42.86781191870	-72.55337937780
66	HEC-RAS/ Setback	West river	Vernon	42.86884880870	-72.55954549630
67	Setback	West river	Vernon	42.85987819620	-72.56153624440
68	Setback	Cersisimo Pool, documented Shad rearing site	Vernon	42.83029480220	-72.55144601360
69	Setback	Ash Swamp Brook	Vernon	42.80113963960	-72.52795359420
70	HEC-RAS/ Setback	For comparison to Ash Swamp Brook Setback	Vernon	42.80036410340	-72.53127295410
71	HEC-RAS	DS of Stuebens Island to compare to top of island	Vernon Riverine	42.77046547060	-72.48571029060
72	Setback	West side below Vernon Dam	Vernon Riverine	42.76516392210	-72.51494254940
73	HEC-RAS/ Setback	DS of Vernon dam Between setback and top of Stuebens Island	Vernon Riverine	42.76504648430	-72.51195782700
74	Setback	Setback adjacent to confluence of CT and Ompompanoosuc River	Wilder	43.75348980380	-72.23021153820
76	HEC-RAS	DS of Sumner Falls	Bellows Riverine	43.56425395690	-72.38264492740
77	HEC-RAS	For comparison to Blow-me-down	Bellows Riverine	43.49397222100	-72.38064722300

Number	Purpose	Comments	Project Area	Latitude	Longitude
		brook			
78	HEC-RAS	US of mainstem constriction	Bellows	43.36864170760	-72.41459322690
79	Setback	Setback on NH side opposite from confluence of Williams River	Bellows	43.16777991160	-72.44835108560
80	Setback	Setback on VT side adjacent to confluence of Williams River	Bellows	43.17591739370	-72.45548921380
81	HEC-RAS	Mainstem near upper end of Vernon impoundment	Vernon	43.08468832310	-72.43256736630
82	HEC-RAS	US of mainstem constriction	Vernon	42.91417164620	-72.52292372770
83	Setback	Setback on VT side DS of Cersisimo	Vernon	42.81489305840	-72.54673626680
84	Setback	Setback - near 119 boat launch	Vernon	42.78760285030	-72.50520188040

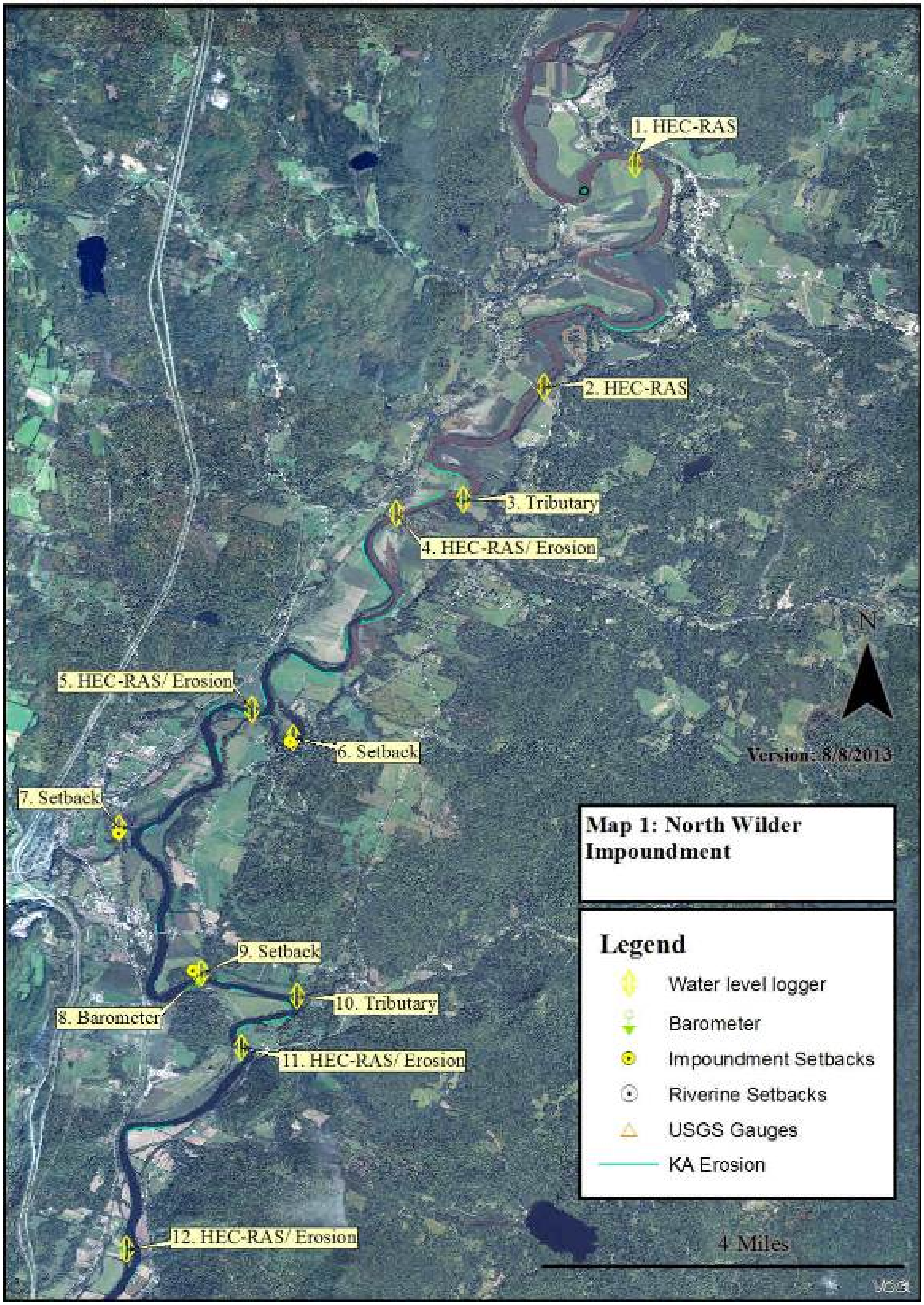

Figure 7-1. Placement of data loggers in north Wilder impoundment.

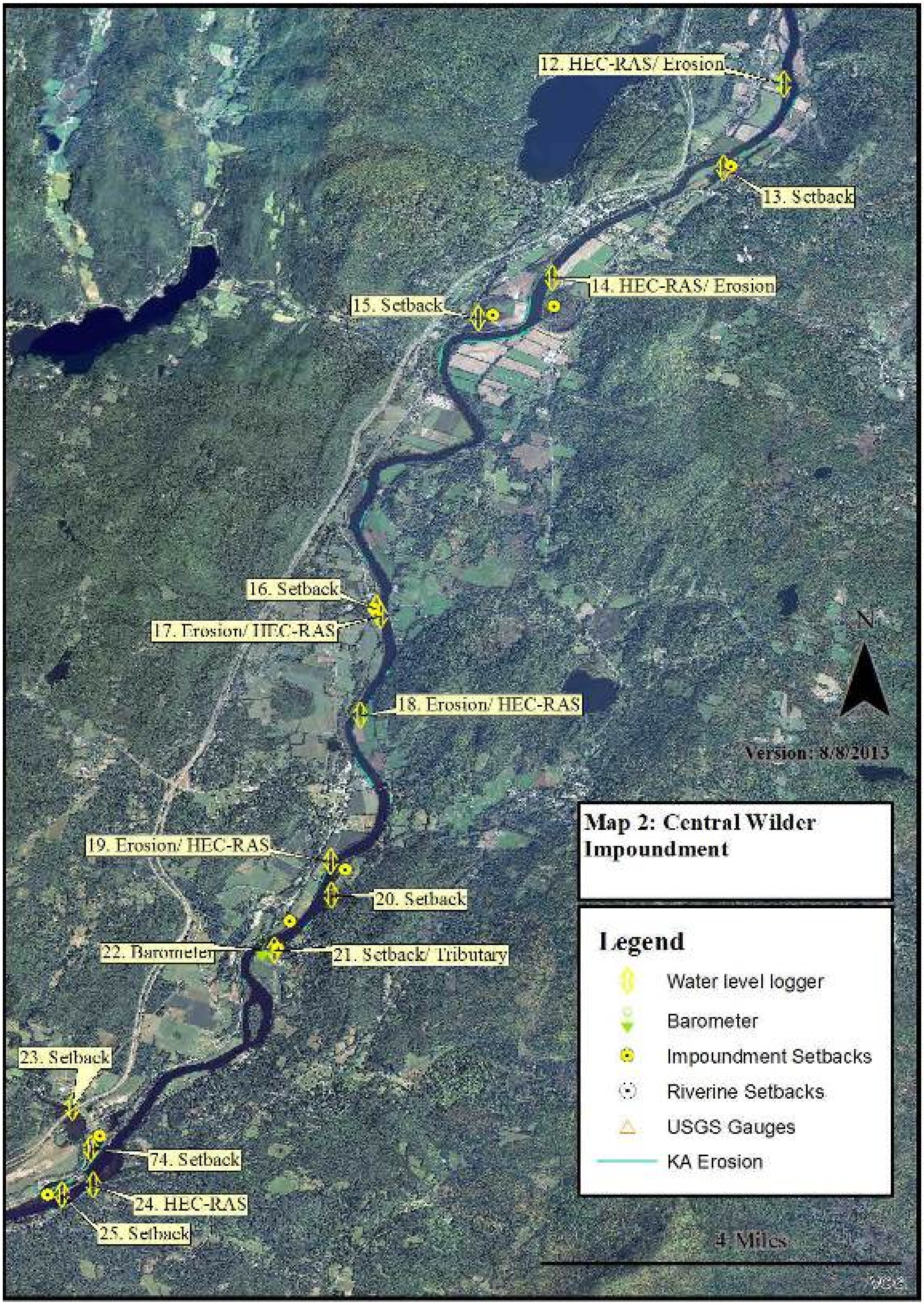

Figure 7-2. Placement of data loggers in central Wilder impoundment.

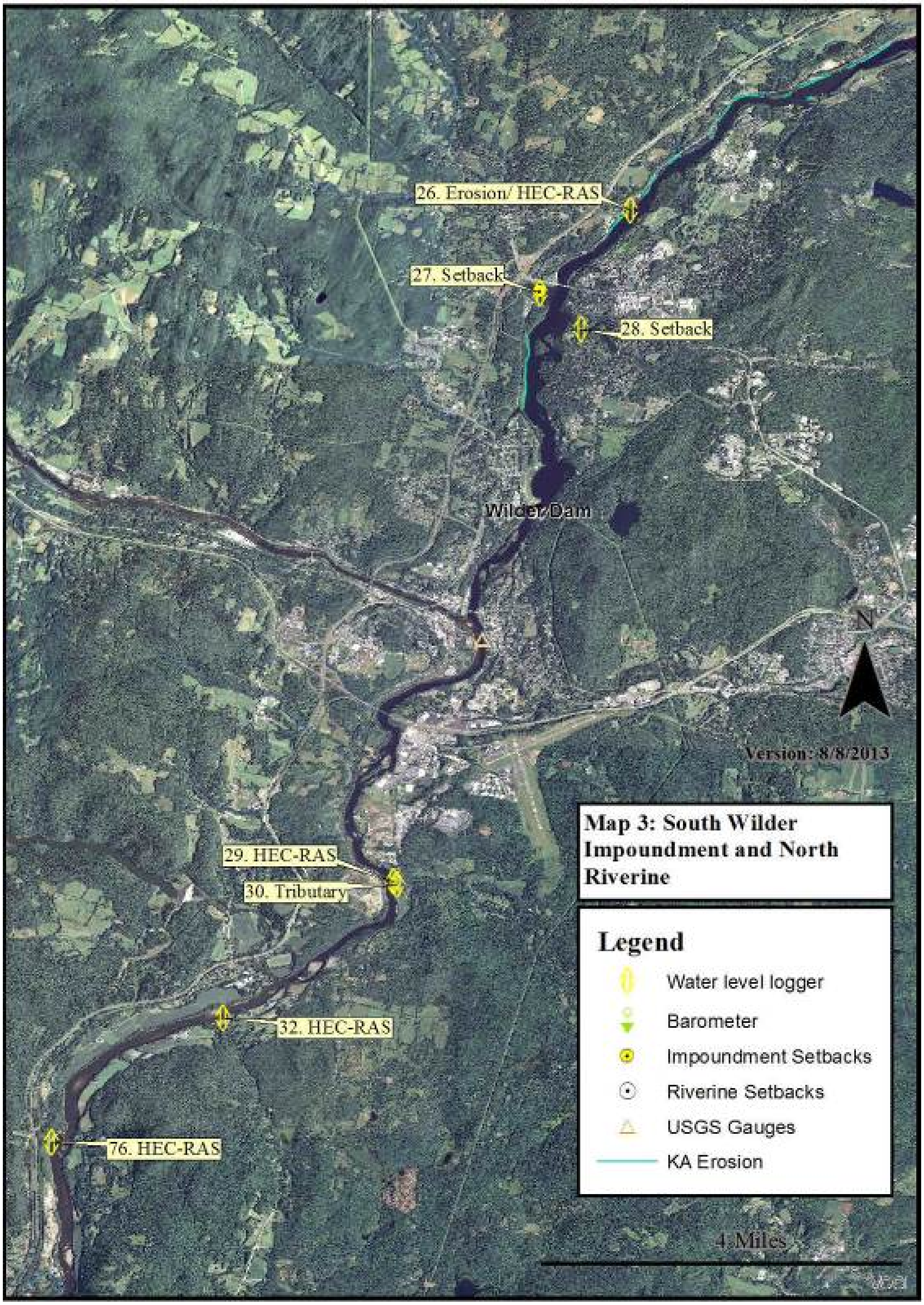

Figure 7-3. Placement of data loggers in south Wilder impoundment and riverine section.

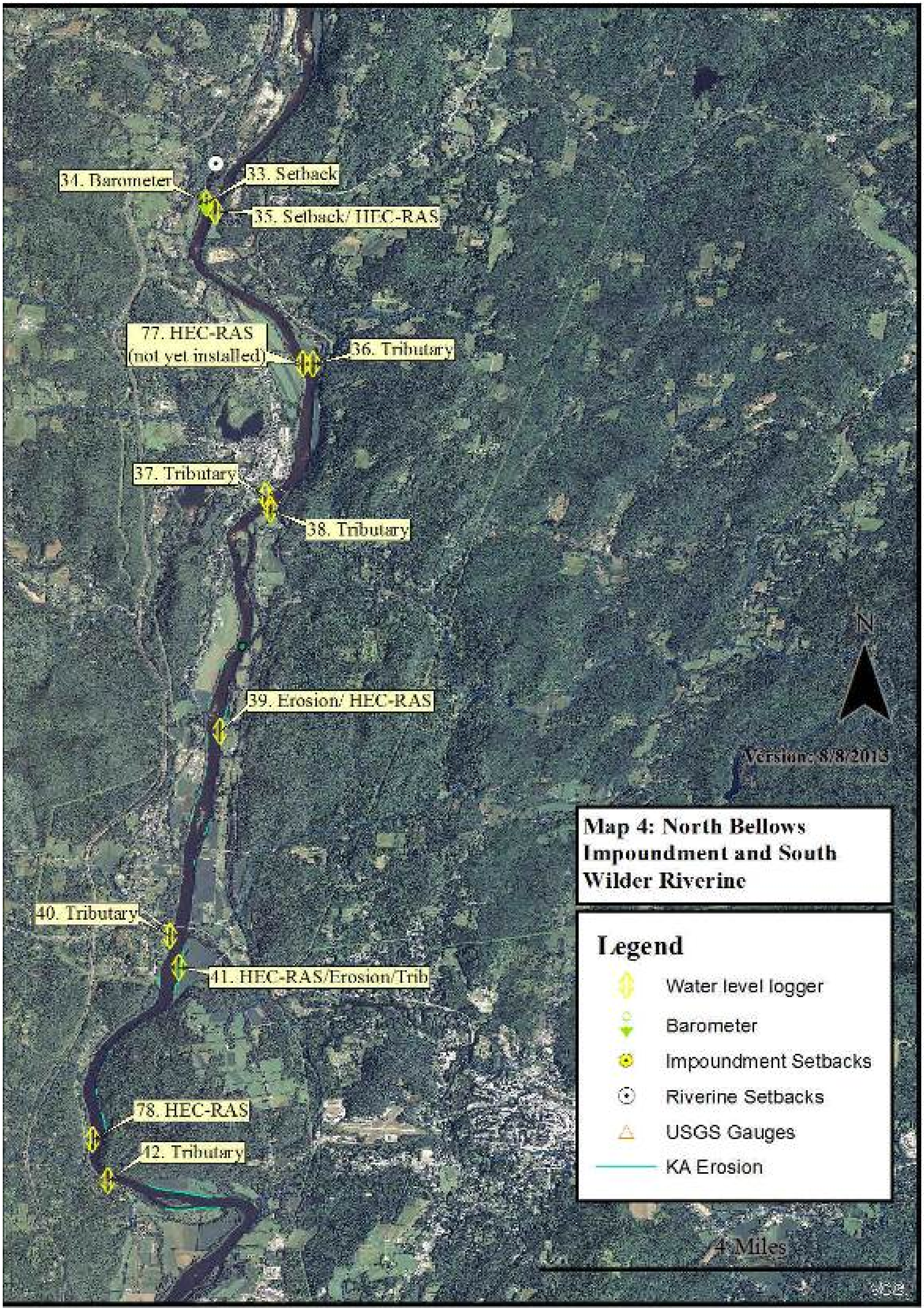

Figure 7-4. Placement of data loggers in north Bellows Falls impoundment.

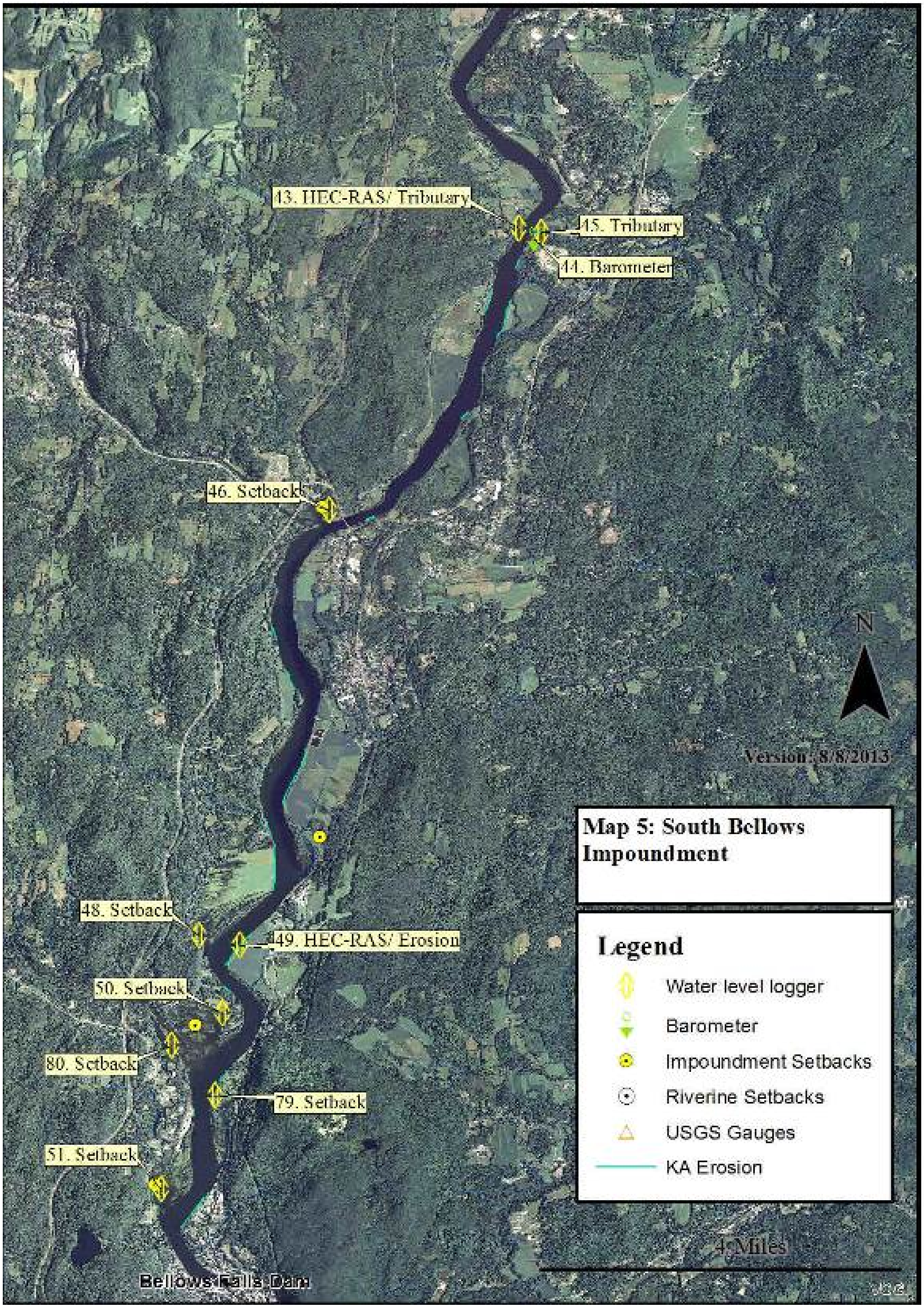

Figure 7-5. Placement of data loggers in south Bellows Falls impoundment.

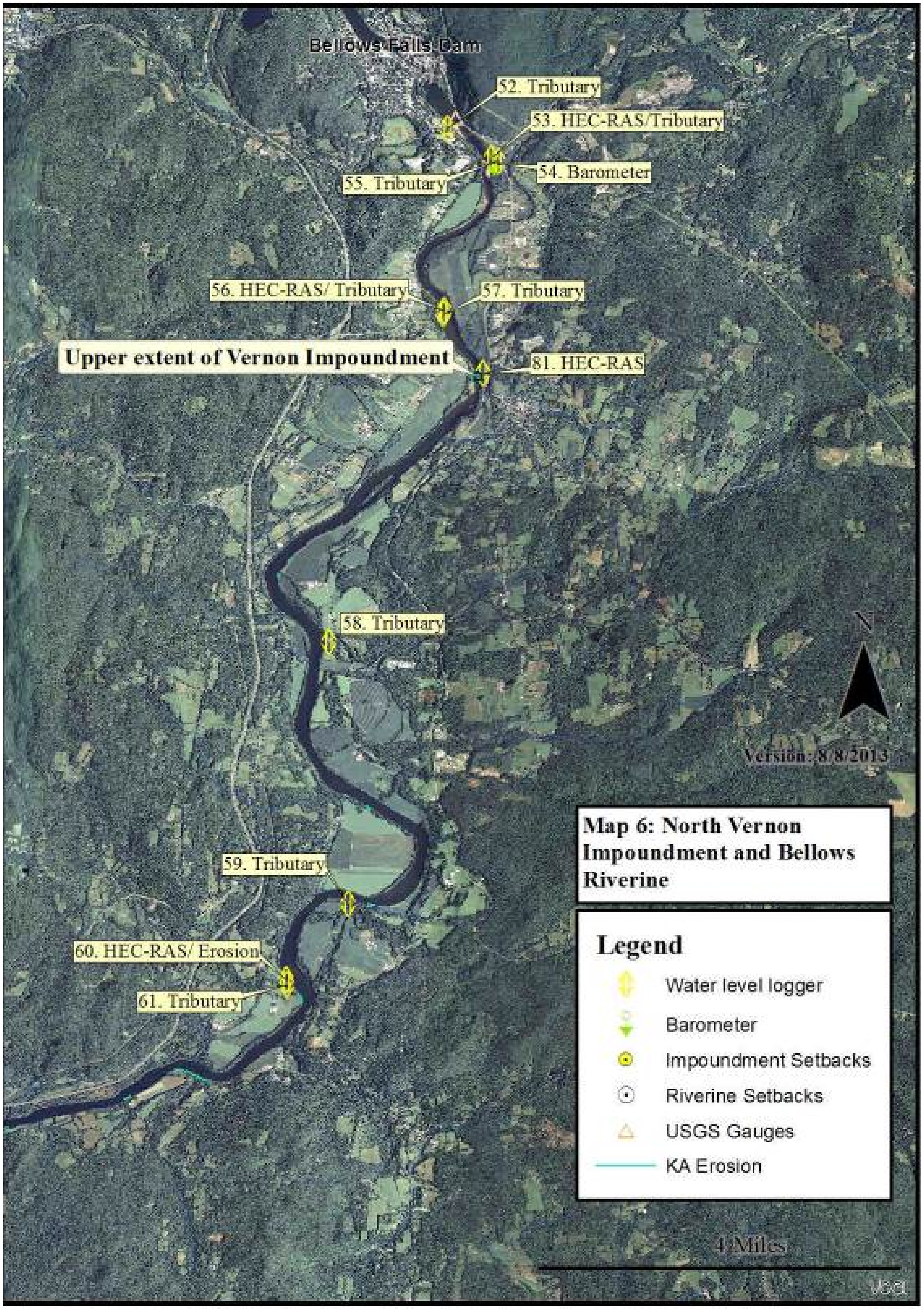

Figure 7-6. Placement of data loggers in Bellows Falls riverine section and north Vernon impoundment.

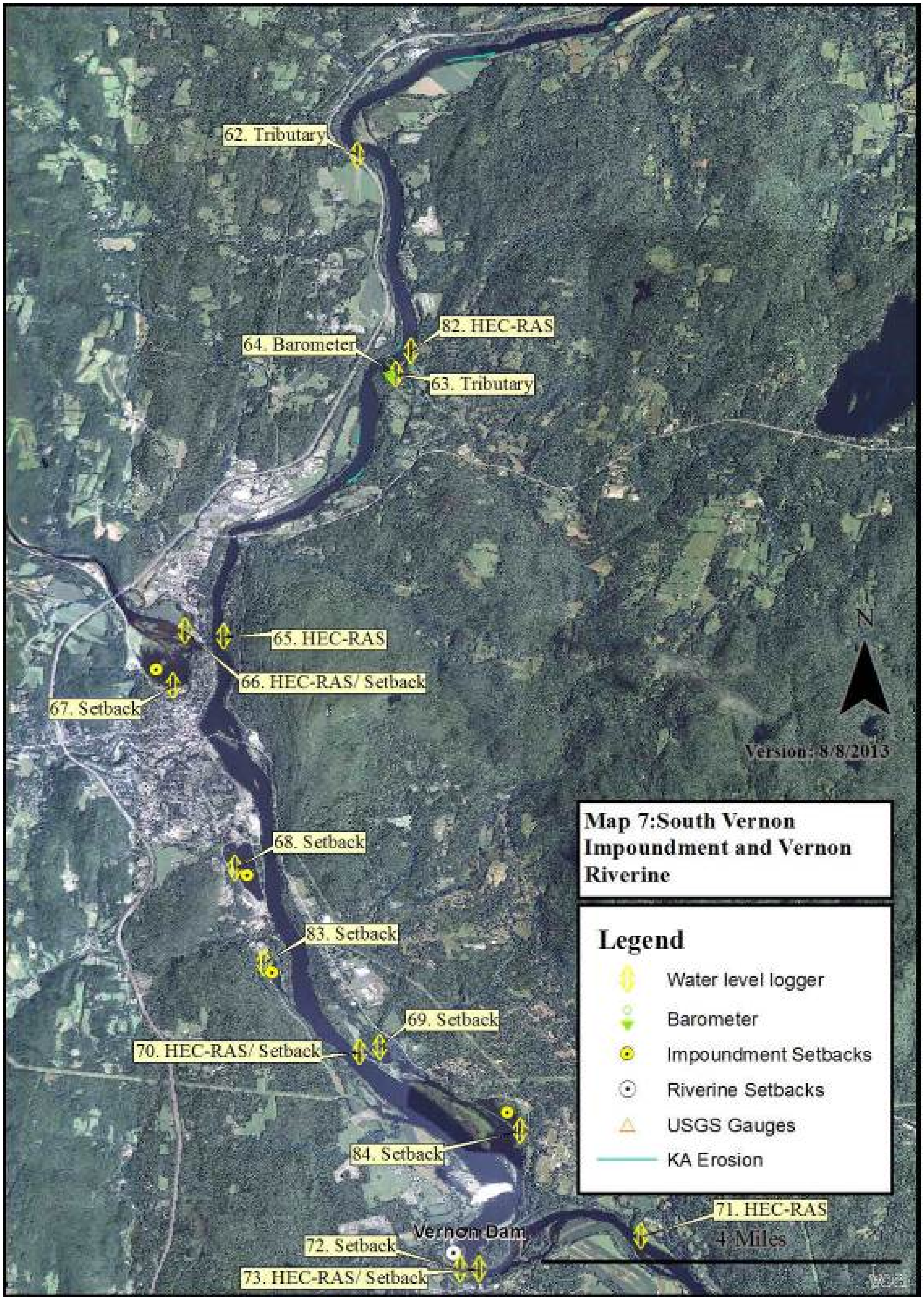

Figure 7-7. Placement of data loggers in south Vernon impoundment and tailwaters.

ANALYSIS

Upon completion of collection, impoundment aquatic habitat and bathymetric data will be processed using ArcGIS. A GIS shapefile consisting of uniquely defined habitat polygons will be created for each impoundment using the habitat data collected during the side scan sonar sampling. A second GIS shapefile, composed of 2-foot bathymetric contours, will be generated for each project impoundment using data collected from the single beam echosounder. Finer resolution (i.e., 1-foot bathymetric contours) will be included in the littoral portions of the shapefile for each impoundment. Tabular and graphical output from the impoundment aquatic habitat and bathymetric study will also be used for presentation and analysis in other study reports that are dependent on results from this study.

Upon completion of the collection of riverine aquatic habitat mapping, the data will be entered into spreadsheets for review and summary. Frequency of habitat types will be developed, and habitat boundaries will be plotted on aerial maps to identify habitat area and locations. Data summaries from this study will also be presented in reports from other studies that are dependent on the results from this study.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The study methodology is consistent with generally accepted practices. Similar lentic and lotic surveys have been conducted for other FERC hydroelectric relicensings including the Brassua Project (FERC No. 2615), Green River Project (FERC No. 2629), Yadkin-Pee Dee Project (FERC No. 2206), Claytor Lake Project (FERC No. 739), Smith Mountain Project (FERC No. 2210), and, most recently, the Turners Falls Project (FERC No. 1889).

DELIVERABLES

A study report will be provided after this 1-year study. Study deliverables will include a presentation to resource agency personnel and other relicensing participants. At a minimum, the report will include a summary of data collected, habitat descriptions, aerial and/or topographic habitat maps, and descriptions of flow and project operations during surveys. In addition, all data used to produce the report will be included in an appendix. A draft final study report will be provided after the study analysis is complete and results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

Impoundment aquatic habitat and bathymetry surveys will be conducted between June 2013 and November 2013. Surveying will take approximately 17 days for the

Wilder impoundment, approximately 12 days for the Bellows Falls impoundment, and approximately 10 days for the Vernon impoundment. It is anticipated that all field work will take approximately 39 days. Data analysis and production of maps will be done completed by January 2014 to support the several dependent studies to be conducted in 2014 and 2015.

Riverine aquatic habitat mapping will occur under summer low-flow conditions and project minimum flows. Surveys may be completed under scheduled shutdown or scheduled maintenance efforts if possible. Generally, a survey conducted by two individuals in a boat or canoe can cover 5 miles a day. Based strictly on river miles, the riverine surveys will take approximately 5 to 6 days. However, boat access constraints in some locations will increase the estimated survey time. Mapping of the Bellows Falls bypassed reach can occur anytime except during spill events because flow levels in this reach are not a function of normal project operations.

LEVEL OF EFFORT AND COST

The estimated cost for this study is $290,000.

REFERENCES

NOAA (National Oceanic and Atmospheric Administration, Office of Coast Survey). 2013. Field Procedures Manual. April 2013. Available at: http://www.nauticalcharts.noaa.gov/hsd/fpm/FPM_2013_Final_5_3_13.pdf.

Yoder, C.O., L.E. Hersha, and B. Appel.2009. Fish Assemblage and Habitat Assessment of the Upper Connecticut River: A Preliminary Result and Data Presentation. Final Project Report. Submitted to U.S. Environmental Protection Agency, Region 1, Boston, MA. Center for Applied Bioassessment & Biocriteria, Midwest Biodiversity Institute, Columbus, OH.

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REVISED STUDY 8

CHANNEL MORPHOLOGY AND BENTHIC HABITAT STUDY

RELEVANT STUDY REQUESTS

NHDES-08; NHFG-08; VANR-08; CRWC-13

STUDY GOALS AND OBJECTIVES

In their study requests, NHDES, NHFG, VANR, and CRWC describe concerns regarding the potential for the Wilder, Bellows Falls, and Vernon Project facilities and operations to affect fluvial processes related to movement of coarse sediment (e.g., gravel, cobble) in the project-affected areas, and associate this concern with potential effects on benthic habitat. Specific concerns include interruption of sediment supply, composition, and transport, and associated effects on fluvial processes, including channel formation. Potentially affected resources include habitat for resident and anadromous fish and benthic habitat for aquatic invertebrates.

The goal of this study is to understand how the projects affect bedload distribution, particle size, and composition in relation to habitat availability for different life-history stages of anadromous and riverine fish, and for invertebrates.

The objectives of this study are to:

- assess the distribution and extent of the existing substrate types including gravel and cobble bars within the project-affected areas; and
- identify the current conditions of the channel and determine the stability of the present substrate/benthic habitat and potential project-related effects on these habitats.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

State resource agencies described various jurisdictional resource management goals for this study, as summarized below:

NHDES	• State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	• General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR

- State water quality standards for designated uses of Class B waters relative to levels of water quality that fully support aquatic biota and habitat.
- VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them (specifically mentioning state-listed mussel species and sea lamprey, a state Species of Greatest Conservation Need (SGCN); and providing fish- and wildlife-based activities including viewing, harvesting and utilization of fish, plant, and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005).
- VFWD specific goals related to freshwater mussel habitats and sea lamprey, a state SGCN.

ASSOCIATION WITH OTHER STUDIES

Implementation of this study will be coordinated with other studies that address erosion, sediment transport, hydraulics, and associated fluctuations in water surface elevations, as well as those that address aquatic habitats for fish and invertebrates.

Information obtained as part of this study will provide information to help assess the suitability of habitats for other dependent studies including Tessellated Darter Survey (Study 12), Resident Fish Spawning (Studies 14 and 15), Sea Lamprey Spawning Assessment (Study 16), Dragonfly and Damselfly Inventory and Assessment (Study 25), and Dwarf Wedgemussel and Co-Occurring Mussel Study (Study 24). This study will also provide data for use in development of alternative scenarios to be run in the Operations Model (Study 5).

This study is also contingent on other studies because it requires substrate information from the Aquatic Habitat Mapping (Study 7) for areas not easily accessible; flow speeds, depths, sheer stress, and sediment mobility developed as part of the Hydraulic Modeling Study (Study 4); sediment supply in the study area from the Riverbank Erosion Study (Study 3); and potentially site-specific information gathered from the Riverbank Transect Study (Study 2), Historical Riverbank Position and Erosion (Study 1), and Tributary and Backwater Fish Access and Habitats Study (Study 13).

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Existing information on channel morphology and benthic habitat in the project-affected areas is limited. The study requests reference previous studies performed on tributaries to the Connecticut River. While the described methodologies used for those studies may be relevant to this study, information that was developed as part of the referenced studies is of marginal relevance to the objectives of this study.

This study will develop baseline information on channel morphology and benthic habitats to inform related studies.

PROJECT NEXUS

Dams may affect geomorphic resources and associated benthic habitat and biota by affecting movement of sediment in riverine systems. This study will assess geomorphic resources and benthic habitat in the project-affected areas and whether identified geomorphic resources and benthic habitats may be directly and/or indirectly affected by project facilities and operations.

STUDY AREA AND STUDY SITES

The study area includes study sites in the riverine reaches in the project-affected areas as well as sites in tributaries that are not in the project-affected areas. Study sites will be selected at three general areas, including:

- upstream (US)-type study sites — upstream from the Wilder, Bellows Falls, and Vernon impoundments;
- downstream (DS)-type study sites — downstream from the Wilder and Bellows Falls dams; and
- tributary study sites — in selected tributaries to the Connecticut River in the riverine reaches downstream from the Wilder and Bellows Fall dams and in tributaries to the project impoundments.

Study sites at the head of the impoundments may be representative of both DS-type and US-type study sites, and will therefore streamline data collection where there may be multiple sites between a given dam and the downstream impoundment. For example, in a case where there are three sites, including 1) immediately downstream from a dam, 2) in the persistently riverine reach downstream from a dam adjacent to a tributary, and 3) in the temporarily inundated area in the vicinity of the upstream limit of the impoundment. The first site would be suitable for evaluating effects of the upstream dam, the second site may be considered a “baseline” site, and the third site would be suitable for evaluating effects of the impoundment. Because TransCanada proposes 12 mainstem sites, they can reasonably be distributed among these sub-types. The aquatics working group will be consulted on the selection of specific sites, which will also be based on results from the Aquatic Habitat Mapping (Study 7), desktop preliminary site selection, and field verification, much of which will occur in 2013.

There are more than 100 tributaries to the Connecticut River within the project-affected areas. For this study, TransCanada proposes to include some with flood control dams and some without and will consult with the aquatics working group on final selection of tributary sites. Five tributaries were specifically suggested by stakeholders in the study plan meeting as follows:

1. White River (Vermont) — Confluence is 2.3 miles downstream of Wilder dam and upstream of the Bellows Falls impoundment.

2. Mascoma River (New Hampshire) — Confluence is 3.2 miles downstream of Wilder dam and upstream of the Bellows Falls impoundment.

3. Williams River (Vermont) — Confluence is within the Bellows Falls impoundment, 2.7 miles upstream of the dam.

4. Saxton's River (Vermont) — Confluence is 1.2 miles downstream of Bellows Falls dam and upstream of the Vernon impoundment.

5. Cold River (New Hampshire) — Confluence is 1.8 miles downstream of the Bellows Falls dam and upstream of the Vernon impoundment.

METHODS

The methods used in this study will include desktop and field study to assess channel morphology and benthic habitats, and are consistent with methodologies described in the study requests. Desktop studies will be used to preliminarily identify field study sites. Study site suitability will be field-verified prior to performing the field studies. Field and desktop studies will be coordinated with other studies as appropriate.

The process of site selection will include:

1. preliminary site identification and selection using desktop studies;

2. development of a preliminary site selection report;

3. working group review of the preliminary site selection report;

4. field-review (with the aquatics working group) of the sites described in the preliminary site selection report;

5. selection of study sites following field visits to the preliminarily identified sites; and

6. development of a final site selection report, which will be incorporated into the study report.

Preliminary (desktop) site selection will include review of aerial photographs, USGS topographic maps, previous project studies, and other readily available information. This work will use applicable substrate information collected in the Aquatic Habitat Mapping Study (Study 7) as well as information such as aerial imagery compiled in the early phases of other concurrent studies. Criteria used in the selection of preliminary study sites using preliminary information will include apparent depositional areas such as mid-channel bars and other features that may suggest active accumulation of coarse-grain sediments. The primary method for preliminary site section will be identification of areas with accumulations of apparently coarse sediment using aerial photographs.

Tributary study sites will be selected at representative locations in the vicinity of the confluences of tributaries with the Connecticut River in the project-affected areas. Selection of the these sites will be based on factors including potential sediment supply from the tributaries to the Connecticut River and include tributaries to the project impoundments and to riverine reaches of the Connecticut River downstream from project dams.

Field verification of the preliminary study sites will be performed to establish approximately 12 DS-/US-type study sites in the project-affected areas and up to 6 tributary study sites that are not in the project-affected areas. Factors considered in the selection of study sites will include safe access for performance of field studies and presence of coarse-grain sediments. Tributary study sites will be selected in a similar manner to the DS- and US-types using existing information (e.g., aerial images), but information developed as part of other studies may not be available because these sites are not in the project-affected areas.

Field study work will be completed in 2014. Field verification of preliminary study sites will be performed in late 2013 after FERC study plan approval or in early 2014 prior to the initiation of site studies. Field studies will occur during low flows in the summer and again during the late summer/early fall of 2014. Field work will include two visits to each site for data collection, including observation and documentation of conditions.

Field study work will be performed during daylight hours and may require the use of small watercraft to safely and efficiently access study sites. Site visits will be coordinated to reduce the potential to encounter high-flow conditions that could preclude effective performance of the field studies. Field investigations will include mapping of study sites using GPS equipment. Standardized field forms will be used and will include pebble counts using established methodologies (e.g., Wolman pebble counts); evaluation of substrate embeddedness; and photodocumentation of each site. Embeddedness refers to the extent to which coarse substrates (i.e., gravel, cobble, and boulders) are covered or sunken into smaller sized substrates, such as sand and silt. Increased embeddedness reduces surface area and interstitial space suitable for use by macroinvertebrates and fish (for shelter, spawning, and egg incubation). In general, habitat suitability increases with decreasing embeddedness. Embeddedness will be quantified and reported using methods as generally described in Chapter 5 of "*Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers*" (Barbour et al., 1999) that was prepared on behalf of the USEPA.

The anticipated size of each study site is expected to be approximately 1 acre. Mapping of each study site will include delineating the approximate boundary using GPS equipment. It is expected that pebble counts and evaluation of embeddedness will be performed at up to six representative locations within each study site; these locations within each study site will be identified as point locations using GPS equipment.

ANALYSIS

Desktop studies will be performed as part of the reduction of field data along with analyses using information developed as part of other concurrent studies as described below. Pebble count and embeddedness data will be reduced and presented using standard methodologies and practices. The desktop analyses of field data will include reductions of pebble count information to provide gradations of coarse-grained material and qualitative descriptions of embeddedness.

Desktop analyses will include review of the HEC-RAS and operations model output (HEC-RAS model to be developed as part of hydraulic modeling in Study 4). Output data from that study's HEC-RAS model that will be used for this analysis include calculated flow speeds and shear stresses. HEC-RAS output data will not be available for tributary study sites, and associated analyses will therefore not be directly applicable to those sites. Tributary study sites will be analyzed using information on channel morphology and benthic habitats collected during site visits. Additional information that may be used will include information on fluctuations in water surface elevations obtained from the Tributary and Backwater Fish Access and Habitats Study (Study 13).

Additional analyses performed as part of this study will include review of information on coarse-substrate dependent biota in the project-affected areas. Reporting will include description of the suitability of the identified substrate characteristics for the dependent biota.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The study approach uses generally accepted methodologies and practices and is consistent with recommended approaches presented in the noted study requests.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

Desktop and field verification work will be initiated in 2013. Ideally, the preliminary site selection report will be provided to interested stakeholders in the late fall of 2013 and followed by site visits for field review in the late fall or early winter of 2013 or prior to the summer field season in the first study year (2014). Field work will be performed under suitable conditions in 2014; initiated in early summer of

2014 and continue through the fall of 2014. A final report including relevant data from related studies will be prepared after data from those studies are available, analyzed, and incorporated into this study's results.

LEVEL OF EFFORT AND COST

The estimated cost for the study is $175,000.

REFERENCES

Barbour, M.T., K.D. Porter, S.K. Gross, and R.M. Hughes. 1999. "Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers: Periphyton, Benthic Macroinvertebrates and Fish." Second Edition. USEPA, Assessment and Watershed Protection Division, USEPA 841-B-99-002, Washington, D.C.

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REVISED STUDY 9

INSTREAM FLOW STUDY

RELEVANT STUDY REQUESTS

FERC-06; FWS-02, -03; NHDES-05, -10; NHFG-05, -10; VANR-06, -07; CRWC-12, -14; TNC-02

STUDY GOALS AND OBJECTIVES

In their study requests, FERC, FWS, NHDES, NHFG, VANR, CRWC, and TNC identified issues regarding the potential effects of current project operations on fish and aquatic resources in the riverine sections downstream of Wilder and Bellows Falls Projects and in the Bellows Falls bypassed reach. Specifically, requesters are interested in answering the following questions:

- are current minimum flows adequate to protect aquatic resources downstream of project dams; and
- what is the effect of current project operations on fish and aquatic resources.

The goal of this study is to assess aquatic resources and habitat in the project-affected areas and in the Bellows Falls bypassed reach under flow conditions affected by project operations.

The overall objective of this study is to assess the relationship between stream flow and resultant habitat of key aquatic species in riverine reaches downstream of project dams. Specific objectives of this study are to:

- compute a habitat index versus flow relationship for key aquatic species in each project reach; and
- use the habitat index versus flow relationship to develop a habitat duration time-series analysis over the range of current operational flows.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

Federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS	• General goals for relicensing including ensuring that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives; and conserving, protecting, and enhancing habitats for fish, wildlife, and plants affected by the projects.
	• General goals related to aquatic resources including protecting, enhancing, or restoring aquatic and riparian habitats; providing

instream flows to meet the requirements of diadromous and resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.

NHDES

- State water quality standards and designated uses for Class B waters including aquatic life, biological and aquatic community integrity, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.

NHFG

- General goals for relicensing including ensuring that protection, mitigation, and enhancement measures are commensurate with project effects and help meet fish and wildlife objectives; and conserving, protecting, and enhancing habitats for fish, wildlife, and plants affected by the projects.
- Specific goals include protecting, enhancing, or restoring aquatic and riparian habitats; providing flows appropriate for resident fish and wildlife including freshwater mussels and benthic invertebrates; and minimizing project effects on water quality and aquatic habitat.
- General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference the New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR

- State water quality standards for designated uses of Class B waters relative to flow alteration, water-level fluctuations, and anti-degradation provisions. The Connecticut River below Wilder dam is listed as impaired waters on the Section 303(d) list due to flow alterations.
- General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.

ASSOCIATION WITH OTHER STUDIES

The Aquatic Habitat Mapping Study (Study 7) must be completed prior to commencement of this study. This study will use information from the aquatic habitat mapping as a basis for selecting study sites and establishing transect locations in riverine reaches relative to overall habitat type distribution, and will assist in identifying potential 2-D study sites. Potential 2-D study sites for this study may be selected based on results of early field work related to the Dwarf Wedgemussel and Co-Occurring Mussel Study (Study 24), the Riverbank Erosion Study (Study 3), and the Tessellated Darter Survey (Study 12), among others.

Studies that could be performed in conjunction with this study include the Bellows Falls Aesthetic Flow Study (Study 32) and the Whitewater Boating Flow Assessment (Study 31), reducing duplication of flow releases necessary to complete those studies.

Completion of this study is dependent on hourly time-step hydrology of project operations and alternatives from the Operations Modeling Study (Study 5) that will be part of the habitat time-series evaluation.

Results of this study will assist in determining effects of downstream flow and water-level fluctuations on fish spawning (Studies 15, 16, and 19) by assessing the relationship between flows and water levels on spawning habitat suitability in riverine reaches.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Little information exists pertaining to aquatic habitat or aquatic resources within flowing reaches downstream of project dams or the Bellows Falls bypassed reach. TransCanada is not aware of any previously conducted instream flow studies. Agency requests note there is no indication how current minimum flow requirements were established or what specific ecological resources they are intended to benefit. As described in the existing project licenses, the minimum flows equate to 0.2 cubic foot per second per square mile (cfsm) of drainage area, as was then recommended by the Coordinating Committee of the Connecticut River Basin Comprehensive Water and Related Land Resources Study, to reestablish historical low-flow levels. The New England River Basin Commission, VANR, and USEPA recommended the same minimum flow, with which FERC concurred. The Technical Committee for Fisheries Management of the Connecticut River Basin, NHFG, and FWS favored a minimum flow of 0.25 cfsm.

The Bellows Falls Project bypasses a 3,500-foot-long section of the Connecticut River. Presently this bypassed reach only receives flow when inflow exceeds the hydraulic capacity of the Bellow Falls station, or through leakage. The bypassed reach receives excess flow less than 30 percent of the time annually. In summer (July-September) the bypassed reach receives excess flow less than 10 percent of the time based upon analysis of 40 years of data as indicated in the Bellows Falls PAD. No information exists on the adequacy of the existing bypass flow regime to protect water quality and aquatic life.

This empirical study will provide information on the relationship between flow and habitat in the Connecticut River riverine sections of the project-affected areas.

PROJECT NEXUS

The projects are currently operated with minimum flow releases dating from issuance of the existing FERC licenses that have not been reviewed since that time. Further, the projects generate power in a daily peaking mode resulting in potential within-day flow fluctuations between the minimum and the maximum capacity of each station. While the current licenses require a continuous minimum flow from the powerhouses of 675, 1,083, and 1,250 cfs, for the Wilder, Bellows Falls, and Vernon Projects, respectively, to what extent these flows protect aquatic resources is unknown in these reaches, especially in the context of the magnitude, frequency, and duration of flow changes. This study will help to establish a baseline condition of effects of licensed project operations on the spatial and temporal aspects of aquatic habitat and aquatic species below the dams and in the Bellows Falls bypassed reach.

STUDY AREA AND STUDY SITES

The study areas consist of an approximately 17-mile river segment downstream of Wilder dam, a 6-mile river segment downstream of the Bellows Falls Project, and the Bellows Falls bypassed reach. In addition, the reach between Vernon dam and approximately 1.5 miles downstream will be evaluated to determine the extent of riverine habitat.

METHODS

A standard approach to instream flow analysis since 1980 has been the Instream Flow Incremental Methodology (IFIM). The IFIM is a structured habitat evaluation process initially developed by the Instream Flow Group of FWS in the late 1970s to allow comparison of alternative flow regimes for water development projects (Bovee and Milhous, 1978; Bovee et al., 1998). The IFIM involves multiple scientific disciplines and stakeholders, in the context of which hydraulic habitat simulation studies are usually designed and implemented.

Critical stakeholder concurrence on study design elements, and overall adequacy for decision-making is one of the principal objectives of IFIM scoping, one of the first identified steps of the methodology (Bovee et al., 1998). Depending on the desires of the participants, the IFIM can be completely comprehensive for all aquatic aspects of flow regulation or tightly focused on topics of specific concern. This study plan uses hydraulic habitat modeling with 1-D and 2-D models as one aspect of the IFIM process and is directed at the evaluation of instream flow needs as related to aquatic habitat.

Specific elements of the Instream Flow Study include:

- habitat mapping;
- study reach, study site, and transect selection;
- identification of key aquatic species and life stages;

- habitat suitability criteria (HSC) selection;
- hydraulic data collection;
- hydraulic and habitat modeling;
- hydrology development;
- time-series analysis; and
- dual flow analysis.

Habitat Mapping

An instream flow study begins with a representative sample of hydraulic and physical habitat conditions within the study reaches. Generally, the samples are represented by cross sections for 1-D models or a topographic grid for 2-D models. This study will use data derived from the Aquatic Habitat Mapping Study (Study 7) to assist in determining the appropriate hydraulic modeling method, the placement of 1-D transects needed to adequately represent habitat in a reach, and the location of any 2-D study sites.

Study Reach, Study Site, and Transect Selection

Preliminary river reaches to be studied are based on hydrology and channel morphology and include:

- Wilder dam to White River (1.5 miles), Wilder tailwater;
- White River to upper extent of the Bellows Falls impoundment (15.5 miles);
- Bellows Falls bypassed reach (3,500 feet);
- Bellows Falls dam to upper extent of the Vernon impoundment (6 miles); and
- Vernon dam downstream approximately 1.5 miles.

Upon completion and analysis of riverine habitat mapping in the summer of 2013, a package with documentation and maps of proposed final reach delineation and study sites (both 1-D and proposed 2-D) will be distributed to the aquatics working group for review and comment. This will include potential transect locations for 1-D sites. Final study site and transect selection will be accomplished with interested working group members in the field. It is hoped this can be done in late fall of 2013 so field work can begin as soon as possible in 2014.

Study sites for 1-D transects will be based on the least available habitat type as derived from habitat mapping. For example, if riffle habitat accounts for the lowest percentage of all types in a reach, study sites would be selected to ensure that riffle habitat type is included in the sample by randomly selecting a riffle habitat unit. If deemed modelable, a transect would be established across that particular mesohabitat unit. Transects will then be placed across other meoshabitat types in the vicinity in relative proportion to the overall mesohabitat distribution and pre-determined habitat representation. Depending on the number of samples needed, other riffle units would be selected through the same process. This process has the advantage of randomizing selection without precluding the use of professional judgment for sites that are unrepresentative or unworkable. This systematic approach also results in clusters of transects, minimizing the time required to travel between transects in the field. Additional transects to represent critical habitat may be added to the sample and will be determined during consultation with the working group prior to or during transect selection.

The number of 1-D transects in a specific reach depends on the overall mesohabitat distribution and projected representation. The final study sites and number of transects will be agreed upon during consultation with the working group. 1-D transects will be located in all reaches except the Bellows Falls bypassed reach.

A 2-D study site may be selected to represent river channel areas or habitat too complex to be adequately modeled using 1-D transects. 2-D study sites are independent and not necessarily representative of all available habitat types. Potential 2-D modeling sites located within the reach between the White River and the upper extent of the Bellows Falls impoundment could include one of the major islands or an area of bedrock ledges known as Sumner Falls. The Bellows Falls bypassed reach, a complex series of bedrock and large substrate components, is also a candidate for a 2-D study. Pending results of the Dwarf Wedgemussel Study (Study 24), a 2-D site may be located to assess the effects of flow on mussels and their habitat. Actual site(s) will be proposed following riverine mapping and analysis. Final decisions will be made during consultation with the aquatics working group prior to the commencement of field studies.

Select Key Aquatic Species and Life Stages to Be Assessed

Target species for the instream flow study will include, but are not limited to:

- American shad,
- fallfish,
- white sucker,
- smallmouth bass,
- walleye,
- longnose dace,
- mussels,
- tessellated darter,
- larval fish and eggs,

- macroinvertebrates, and
- sea lamprey.

A proposed list will be distributed during the consultation process along with selection of HSC. Inclusion of identified species and life stages is contingent upon the availability of appropriate HSC.

Select Habitat Suitability Criteria

Substrate size and cover classifications can vary greatly depending on the source of HSC. Preferably, HSC should be determined prior to field data collection if substrate and/or cover are a major component of the curves. This allows field personnel to document the specific information needed rather than try to collect an extensive amount of information to cover all possible data needs.

Selection of HSC will be completed with working group consultation. No HSC are proposed at this time. Prior to commencement of the field portion of this study, a list of candidate HSC curves will be compiled based on the target species listed above and any others identified through consultation. This list will be distributed to the aquatics working group for review and approval. Additional HSC may be added during the consultation process. It is anticipated that the initial proposed HSC will be distributed in the winter of 2013 at which time a meeting with the working group will be scheduled.

Hydraulic Data Collection

1-D Transects

Calibration flows (discharge and related water levels) are used to develop stage-discharge rating curves for each transect. The range of calibration flows depends on project operations and the agreed-upon modeling range among TransCanada and the aquatics working group. For this study it is anticipated that calibration flow measurements will take place near the base minimum flow, at ½ to ¾ the maximum operational flow and at an intermediate flow. The basic rule-of-thumb for 1-D hydraulic models is they are most reliable between 0.4 times the low calibration flow and 2.5 times the high calibration flow. A minimum of three sets of calibration flow measurements will be acquired for each transect. When feasible, middle flow levels will be estimated based on rating curves from the Hydraulic Modeling Study (Study 4) HEC-RAS transects, thus reducing field time. Target calibration flows will be determined in consultation with the working group.

One complete set of depths and velocity measurements will be collected at each transect at the target high flow or the flow level that can be effectively and safely measured. Velocity data will be collected using an Acoustic Doppler Current Profiler (ADCP) mounted on a boat or encased in a rigid 4-foot trimaran hull that can be tethered to the side of a boat or other type of vessel. In areas that cannot be effectively measured using the ADCP (such as shallow areas or areas inaccessible to a boat), velocity measurements will be acquired by wading techniques using electromagnetic or mechanical flow meters attached to top-set rods. If wading, mean column velocity will be determined by a single measurement at six-tenths of the water depth in depths less than 2.5 feet, and a two-tenths and eight-tenths measurement for depths between 2.5 feet and 4.0 feet. All three points will be measured where depths exceeded 4.0 feet, if possible. The number of verticals (depth, velocity, and substrate points) across each transect will depend on ADCP settings and boat speed. In most instances data are collected at intervals of between 1 to 2 feet.

Substrate and/or cover information will be collected across each transect at low flow or when visibility is best. For deep areas where the bottom is not visible, an underwater camera may be deployed to discern substrate and cover. Classification of substrate and cover will be determined based on agency consultation in the selection of HSC.

Field data collection and the form of data recording will basically follow the guidelines established in the Instream Flow Group field techniques manuals (Trihey and Wegner, 1981; Milhous et al., 1984; Bovee, 1997). Additional quality control checks that have been found valuable during previous applications of the simulation models will be employed. Basic field measurement protocols are as follows:

- Staff gages are established and continually monitored throughout the course of collecting data at each study site.
- Headpins and tailpins consisting of either rebar or spikes will be established for each transect.
- An independent benchmark, an immovable object, or additional rebar will be established for each transect or set of transects.
- All elevation surveying will be done using auto-level and telescoping stadia rod. Upon establishment of headpin and tailpin elevations, or during calibration flow surveys, a level loop will be shot to check the auto-level measurement accuracy or field errors. Allowable error tolerances on level loops will be set at 0.02 foot.
- Water surface elevations will be measured on both banks on each transect. If possible, on more complex transects such as riffles with uneven water surface elevations, additional measurements may be taken across a transect.
- Pin elevations and water surface elevations will be calculated during field measurement and compared to previous readings to confirm accuracy.
- Flow meters will be calibrated and monitored on a daily basis. Marsh-McBirney Flo-Mate electromagnetic meters are calibrated to zero velocity and are accurate to ±0.05 foot/second. Mechanical AA and pygmy meters are calibrated using a spin test and are accurate to ±3.4 percent of the true velocity at 0.5 foot/second and ±1.5 percent of the true velocity at 3.0 feet/second.

- Photographs will be taken of all transects at the three calibration flows. An attempt will be made to shoot each photograph from the same location at each flow level.

Field Data Collection (2-D)

The 2-D model requires a detailed topographic and bathymetric map of the study site. Bathymetry data will be collected using an ADCP or depth transducer and a Real Time Kinematic (RTK)-GPS. Out-of water topography will be acquired with a stationary and/or robotic total station also tied to an RTK-GPS. In the event LiDAR data are available, this may also be incorporated, which would reduce the amount of field time needed. Bathymetry will be acquired at the highest flow possible to reduce the amount of time needed to survey bank areas. In addition to topography, substrate and cover information will be collected by identifying and surveying substrate and/or cover breaks in enough detail to be incorporated into the model.

Upstream and downstream boundaries of a 2-D study site require rating curves that cover the range of flows that may be modeled. A single calibration flow with associated water surface elevations is required for a 2-D site. Additional flows and elevations will be collected in conjunction with 1-D transect data collection to assist with model calibration. Water surface elevation measurements can take place independent of the topographic mapping.

ANALYSIS

Hydraulic Modeling and Habitat Modeling

For 1-D applications in this study, the hydraulic models and habitat index simulations will be derived from the System for Environmental Flow Assessment computer program (SEFA, http://sefa.co.nz/). This program was developed jointly by originators of the primary models used in instream flow studies, Tom Payne (Riverine Habitat Simulation, or RHABSIM), Bob Milhous (Physical Habitat Simulation System, or PHABSIM), and Ian Jowett (River Hydraulics and Habitat Simulation Program, or RHY-HABSIM) and merges and expands on the capabilities of these older software packages.

For 2-D applications in this study, the River2D model will be used (Steffler and Blackburn, 2001). River2D is a 2-D, depth-averaged hydrodynamic and fish habitat model developed for use in natural streams and rivers. The fish habitat module is based on the PHABSIM habitat index approach, adapted for a triangular irregular spatial grid network. Habitat analysis uses habitat suitability inputs like those used by PHABSIM.

Time-series and Hydrology

The major basis for habitat time-series analysis is that habitat is a function of stream flow and that stream flow varies over time. A habitat time-series displays the temporal habitat change for a particular species and life stage during selected seasons or critical time periods under various flow scenarios. Results will be provided as habitat time-series and habitat duration graphs, which will allow evaluation of habitat over the selected time periods. Hydrology and flow scenarios to be assessed will be determined from results of the operations model (Study 5) and with input from the working group.

Dual Flow Analysis

The concept of a dual flow analysis (also known as effective habitat) is that some aquatic species or life stages become established at or use particular locations that provide a given amount of suitable habitat under certain flows, and assumes the organism is either unable to move to more suitable habitats (mussels for example) or requires relocating to more suitable habitats (spawning for example). If the flows change or fluctuate, the location may provide less, more or no suitable habitat under a fluctuating flow regime. The evaluation of flow fluctuations involves comparing habitat at a range of flows with habitat at a base or given flow. The amount of usable habitat under a flow fluctuation is the minimum amount of habitat at a particular location over the fluctuation range. The numerical evaluation of habitat suitability is to sum the available habitat over a reach, study site or individual transects. The assumption is that the habitat value of a location is the minimum of the habitat at the low point of the flow fluctuation, at the high point of the fluctuation, or the habitat at base flow. Thus, at each simulated flow, the amount of suitable habitat is the amount of habitat that overlaps in space the suitable locations that were available at the base flow. Results will be presented in tabular and graphic form suitable for evaluating the amount of habitat between two or more paired flows. Determination of particular species and life stages that will be assessed using Dual Flow Analysis will be made in consultation with all interested parties and the aquatics working group.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The study methodology using IFIM is consistent with generally accepted practices and was identified by resource agencies as the preferred method.

DELIVERABLES

Upon completion of the Aquatic Habitat Mapping Study (Study 7), TransCanada will produce and distribute a pre-selection package of potential study sites, transect locations and species and life stage lists, and HSC for working group review, discussion, and approval.

A report will be prepared that presents methods, analysis, and results of the study. It will also include summary of data collected, hydraulic modeling results and calibration details, and habitat modeling including time-series and dual flow analysis results. A draft final study report will be provided after the study analysis is complete and the results are available. The report will include appropriate tables and graphs to support the study, analysis, and results. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

Habitat mapping will completed in the summer of 2013. Proposed instream flow study reaches, sites, and transects will be distributed to the working group in the fall of 2013 followed by study site and transect selection based on consultation. Field work to collect hydraulic data will commence in spring 2014. Most field work will be completed in 1 year, though additional data collection may be necessary depending on the results of initial modeling runs, results of associated studies, and identification of additional study needs. Below is tentative schedule for the instream flow study:

Task	Proposed Completion Date
Habitat Mapping (field data collection)	August/September 2013
Habitat Mapping (analysis and results)	October 2013
Proposed study reaches, sites and transects and consultation	October 2013
Study site and transect selection (field) and consultation	Fall 2013?
Proposed species and life stage list and HSC and consultation	November 2013
Final HSC	Winter 2013
Determine target flows for 1-D and 2-D sites	Winter 2013
Commence field data collection	Spring/Summer 2014
Hydraulic and Habitat modeling	Fall 2014
Determine additional data collection needs	Fall 2014
Draft Report	Fall/Winter 2014
Final Report	December 2014

LEVEL OF EFFORT AND COST

The preliminary estimated cost of this study is dependent upon on the number of 2-D study sites and the number of 1-D transects used. Estimated study costs for three 2-D sites and as many as 50 1-D transects is $350,000 to $500,000. This estimate does not include costs for additional 2-D sites identified as sites of interest in other studies (e.g., Dwarf Wedgemussel and Co-Occurring Mussel Study (Study 24) and Riverbank Erosion Study (Study 3).

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REVISED STUDY 10

FISH ASSEMBLAGE STUDY

RELEVANT STUDY REQUESTS

FERC-07; FWS-15; NHDES-13; NHFG-13; VANR-13; CRWC-15; TNC-04

STUDY GOALS AND OBJECTIVES

In their study requests, FERC, FWS, NHDES, NHFG, VANR, CRWC, and TNC requested a baseline fish assemblage study for the Wilder, Bellows Falls, and Vernon Projects. As stated in the project PADs, a thorough and comprehensive assessment of the fish assemblage present in the project-affected areas of the Bellows Falls and Wilder Projects had not been conducted.

Study requests indicated that previous surveys conducted by Vermont Yankee in the Vernon impoundment relied on sampling techniques and objectives that differ from those requested for this study. TransCanada finds that, when combined with the sampling methods in this fish assemblage study plan, the surveys previously conducted by Vermont Yankee in the Vernon impoundment will provide a valuable source of information related to the occurrence, distribution, and relative abundance of fish species present in the Vernon Project-affected area because those studies relied on a variety of sampling methods (boat electrofishing, trap nets, and beach seining) and have been conducted on a seasonal basis over an extended period of years.

The goal of this study is to characterize the occurrence, distribution, and relative abundance of fish species present in the project-affected areas. Specific objectives include:

- documentation of fish species occurrence, distribution, and relative abundance within the project impoundments, tailwaters, and downstream riverine sections;
- comparison of historical records of fish species occurrence in the project-affected areas to the results of this study; and
- description of the distribution of resident/riverine and diadromous fish species within the reaches of the river and in relationship to data gathered by related studies, state agencies’ surveys, and other information as available (e.g., surveys conducted by Vermont Yankee in the Vernon impoundment).

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS	• General goals for relicensing including ensuring that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives; and conserving, protecting, and enhancing habitats for fish, wildlife, and plants affected by the projects.
	• General goals related to aquatic resources including protecting, enhancing, and restoring aquatic and riparian habitats; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.
NHDES	• State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	• General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference the New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).
VANR	• State water quality standards for designated uses of Class B waters relative to levels of water quality that fully support aquatic biota and habitat.
	• General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.
	• VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety. Goals reference the Vermont Fish and Wildlife Strategic Plan (VFWD, 2006), including fish SGCN.

ASSOCIATION WITH OTHER STUDIES

Resident/riverine and diadromous fish species sampled from the project impoundments, tailwaters, and downstream riverine sections during this study will be combined in GIS with habitat information collected during the Aquatic Habitat Mapping Study (Study 7) to examine the relationship between species occurrence, distribution, and relative abundance as it relates to habitat types. Species occurrence, distribution, and relative abundance data collected during this study may also be used in a supportive role to augment aspects of species-specific studies (e.g., the Sea Lamprey Spawning Assessment [Study 16], American Eel Survey [Study 11], and American Eel Upstream Passage Assessment[Study 18]). In particular, detection of sea lamprey and American eel during this study may provide valuable insight on particular aspects of those studies such as lamprey spawning areas or eel congregation areas.

Information collected on the presence and relative abundance of small-bodied benthic fish species during the Tesselated Darter Survey (Study 12) will be used to augment findings related to this study and will enhance the knowledge of species occurrence, distribution, and relative abundance in the project areas. Where habitat and sampling gears are appropriate (e.g., backpack electrofish sampling in the Bellows Falls bypassed reach), sampling for both this study and Study 12 will be conducted concurrently.

Information collected during this study will also be used in the development of a target species list for the Fish Impingement, Entrainment, and Survival Study (Study 23). The determination of that target species list is dependent on the findings of this study.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Some site-specific data on general species presence/absence were provided in the Wilder and Bellows Falls PADs, and only minimal additional information on fisheries resources is available. Therefore, fishery agencies and other stakeholders requested additional fisheries abundance data to assess potential effects of project operations on this resource.

The most relevant fish study related to the Wilder and Bellows Falls Project-affected areas is a Connecticut River electrofish survey conducted during 2008 (Yoder et al., 2009). Whereas some sampling was conducted in project-affected areas during the 2008 survey, the total number of sample locations was limited, and each location was sampled only a single time during the later summer-early fall. Considerable fish data have been collected by Vermont Yankee for many years in the vicinity of Vernon dam (Downey, 1985; Binkerd et al., 1990; Downey, 1990; Smith et al., 1995; Smith, 1995; Normandeau, 2012). NHFG also conducts periodic surveys in the Connecticut River near the projects, but those surveys also have not been extensive and do not meet the objectives of this study. Data collected through this study will contribute substantially to the existing fisheries data.

PROJECT NEXUS

Operations at the Wilder, Bellows Falls, and Vernon Projects potentially affect the availability of instream habitat on which fish species depend. Habitat for fish species may be related to project operations in terms of flow (water depth and velocity and their timing, duration, frequency, and rate of change), as well as the interactions of flow with other habitat variables such as substrate, vegetation, and cover. Operations both upstream (i.e., impoundment levels) and downstream (i.e., flow fluctuations) may affect habitat, which may consequently lead to changes in the distribution, abundance, and behavior of fish species.

This study will help to establish a baseline condition on the extent of the fishery of the Connecticut River in the project-affected areas under current operations and will sample the available habitat within project operational ranges for resident and diadromous fish populations.

Furthermore, several fish species considered to be an SGCN in New Hampshire and/or Vermont have been documented in the project-affected areas, and this study will assist in identifying those populations.

STUDY AREA AND STUDY SITES

Sampling will be conducted to characterize the baseline fish assemblage within project-affected areas from the upper extent of the Wilder impoundment downstream to Vernon dam, as well as in the Bellows Falls bypassed reach. This approximately 120-mile reach of the Connecticut River has been initially divided into seven geographic reaches delineated based on a combination of general river morphology and project structures. These geographic reaches are as follows:

- Wilder impoundment (RM 262.4 - 217.4);
- Wilder downstream riverine corridor (RM 217.4 – 199.7);
- Bellows Falls impoundment (RM 199.7 – 173.7);
- Bellows Falls bypassed reach (approximately 3,500 feet long);
- Bellows Falls downstream riverine corridor (RM 173.7 – 167.9);
- Vernon impoundment (RM 167.9 – 141.9); and
- Downstream of Vernon dam to the downstream extent of Stebbins Island (RM 141.9 – 140.4).

Following review of the aquatic habitat mapping (Study 7), each geographic reach will be stratified based on habitat characteristics. The total number of sampling locations within each geographic reach will be randomly placed proportional to habitat type frequency (e.g., if 50 percent of a particular geographic reach is shallow, riffle habitat than 50 percent of the total number of sampling locations for that geographic reach would be randomly placed within that habitat type). Each stratum will be delineated in 500-meter segments using ArcGIS. As long as habitat is available, effort will be made to ensure that a minimum of three sampling locations are placed within each strata (i.e., habitat type) within a particular geographic reach. A total of 12 to 15 randomly selected 500-meter segments will be selected (proportional to habitat availability) in each of the geographic reaches with the exception of the Bellows Falls bypassed reach and area downstream of Vernon dam where, as physically permitted, a total of 3 randomly selected 500-meter segments will be placed due to the short nature of those geographic reaches.

METHODS

Sampling techniques for this study include electrofishing (boat, pram, and backpack), gill netting with experimental mesh nets, trap netting, and beach seining. Given the large sampling area (approximately 120 river miles) and complex habitat diversity, the selection of a single gear type to effectively sample all randomly selected locations is not realistic. However, prior to any sampling, appropriate methodologies will be identified for each stratum (i.e., habitat type) and those methodologies will be consistently used over all geographic reaches to avoid gear bias for within-habitat type comparisons.

Sampling locations will be uniquely keyed by an identification code, and a more precise location will be identified using GPS such that latitude/longitude coordinates of the locations or limits of the sampling areas can be used to present the information in a GIS dataset. Sampling will be conducted across multiple seasons including spring (May-June as flow conditions permit), summer (July-August), and fall (September-October). Sampling segments will be randomly selected within each season (spring, summer, fall).

Boat Electrofish

Boat electrofish sampling will be the primary sampling technique conducted within each randomly selected 500-meter segment for all strata (i.e., habitat types) with adequate water depths and available access for the sampling equipment. Should the field crew be unable to sample a particular segment due to either safety or access issues, a randomly selected alternate location within the same habitat type will be chosen. Each randomly selected 500-meter shoreline segment will be sampled during the evening and nighttime hours and sampling will consist of a single pass along the shoreline and out to water depths of about 6 to 8 feet in an upstream direction. During boat electrofish sampling, scap netters on the bow of the electrofish boat will net and place stunned fish in an onboard live well for processing once the full 500-meter sample segment is complete. Following completion of the full 500-meter sample segment, biological data will be collected from captured fish. All fish captured will be identified to species, enumerated, measured (total length [TL]), weighed and released. If large numbers (>25) of small fish (e.g., young-of-year [YOY] or cyprinids less than 100 millimeters [mm]) are captured, they will be grouped, enumerated, batch-weighed and representative length samples will be taken from a small and large individual to be representative of the group.

The date, start and end time, sampling effort (seconds fished), water quality parameters (temperature, DO, pH, conductivity, and turbidity), weather, cloud cover, water depth, and velocity will be recorded for each randomly selected sample segment.

Experimental Gill Net

The use of experimental gill nets will be supplemental to boat electrofishing within all strata (i.e., habitat types) with adequate water depths and flow conditions to allow for proper performance of the nets. Gill net stations will be established at a suitable location within the 500 meter segment and are intended to target fish species that use areas too deep or far from shore to effectively sample by boat electrofishing or other means. Nets will be deployed in a manner to allow sampling above the bottom substrate. Gill nets will be an experimental design and will be constructed using 4 to 5 panels of increasing mesh size (e.g., 0.75-, 1.0-, 1.5-, 2.0-, and 2.5-inch stretch mesh). Gill nets will be deployed perpendicular to the shoreline in areas where water depths are greater than the net height and capture area is maximized. Nets will be set and allowed to fish for an approximate 2-hour period to minimize netting mortality. Gill net samples will be conducted during the evening and night hours when fish species are most likely to be captured by the gear due to the reduced visibility associated with low light levels. Field crews will record the set coordinates for each sample. In addition, the set and pull date and time, water depth, velocity, water quality (temperature, DO, pH, conductivity and turbidity), and weather conditions will be recorded. The total fish catch will be processed following the same methods as described above for boat electrofish samples.

Trap Net

Trap netting will supplement boat electrofishing within all strata (i.e., habitat types) where conditions (i.e., water depths and flows) are inappropriate for experimental gill nets (e.g., setback habitat). Trap nets will be deployed with their primary lead set perpendicular to the bank, and the wings will be extended at an approximate 45 degree angle. Care will be taken to avoid setting trap nets in areas with sudden changes in bottom topography because gear effectiveness can be reduced by setting on steep banks or in deep water; and in areas that could become dewatered due to flow fluctuations over the set period. Nets will be set and allowed to fish for an approximate 24-hour period prior to pulling. Field crews will record the set coordinates for each sample. In addition, the set and pull date and time, water depth, velocity, water quality (temperature, DO, pH, conductivity, and turbidity), and weather conditions will be recorded. The total fish catch will be processed following the same methods as boat electrofish samples.

Bald eagles are known to inhabit project-affected areas, and some stakeholders indicated in the study plan meeting that trap nets could possibly entangle eagles. Bald eagles are federally protected under the Bald and Golden Eagle Protection Act (16 U.S.C. §§ 668-668c) and are state-listed as threatened in New Hampshire and endangered in Vermont. As such, if trap nets are deemed necessary, TransCanada will consult with agencies on trap placement and will obtain all necessary species permits in advance of trap net deployment.

Pram / Backpack Electrofish

For all strata (i.e., habitat types) where the use of boat electrofishing is inappropriate due to water depths or access, pram or backpack electrofish sampling will be conducted. Should the field crew be unable to sample a particular randomly selected segment due to either safety or access issues, a randomly selected alternative location will be chosen within the same habitat type. Sampling will be conducted by anchoring a fine mesh seine at the downstream end of the sample station. A pram or backpack electrofish unit and two to three biologists will move in a downstream direction towards the seine while actively netting stunned individuals and kicking the substrate to drive additional stunned individuals towards the collection net. To ensure crew safety while wading in moving water habitat, pram and backpack electrofish sampling will be conducted during daylight hours. Field crews will record the start and end coordinates for each pram/backpack electrofish sample. In addition, the date, start and end time, sampling effort (seconds fished), water depth, velocity, water quality (temperature, DO, pH, conductivity, and turbidity), weather, and dominant substrate will be recorded. Factors such as the presence/absence of cover and proportion of available cover will also be recorded for each sample. The total fish catch will be processed following the same methods as described above for boat electrofish samples.

Seine

For any strata (i.e., habitat type) where these use of pram or backpack electrofish is less effective (e.g., shallow flat habitat with limited cover) a seine net will be used to assess the fish assemblage. Sampling will be conducted by anchoring one end of the seine net on the shoreline and extending the second end of the net out and away from the shoreline then back to the starting point in a circular manner. Care will be taken to ensure that the lead line maintains contact with the bottom substrate to avoid fish moving under the net. Seine sampling will be conducted during the daylight hours. Field crews will record the positional coordinates for each seine sample. In addition, the date, time, water depth, velocity, water quality (temperature, DO, pH, conductivity, and turbidity), weather, and dominant substrate will be recorded. Factors such as the presence/absence of cover and proportion of available cover will also be recorded for each sample. The total fish catch will be processed following the same methods as described above for boat electrofish samples.

ANALYSIS

Data recorded for each sample will include the specific location (coordinates), collection date and time, gear type, sampling effort (duration of electrofish or net set time) and associated habitat/environmental variables including water quality parameters (temperature, DO, pH, conductivity, and turbidity), weather, cloud cover, water depth and velocity as well as project operational information and conditions (upstream discharge and or impoundment elevation at the dam) at the time of sampling. These data will be reported in tabular format and included in the attributes table associated with the sampling location included in the GIS datasets.

Habitat and substrate information for each sample location will be obtained following the integration of sampling coordinates and available habitat, as determined by aquatic habitat mapping (Study 7), in GIS and will be also be presented in the attributes table associated with each unique sampling location. An appendix table of the biological data (i.e., length and weight) will be provided for all fish caught by location and season.

Summary statistics will be calculated by habitat type and included in the GIS dataset on a seasonal basis. Summary statistics will include taxa richness, species composition, Shannon Diversity Index, and relative abundance (i.e., catch-per-unit-of-effort [CPUE]). Values of CPUE for each habitat type and sampling technique will be calculated as the sum of catch from all samples within that habitat type by the sum of the effort expended within that habitat type. CPUE values will be presented for all individuals of a particular species as well as by size classes (e.g., YOY, juvenile, adult). Measures of variance (e.g., standard deviation and coefficient of variation) will be calculated with the latter permitting direct comparisons of catch among gear types. Relative abundance will be examined on a seasonal basis as it relates to habitat/environmental variables (e.g., water quality, habitat, velocity) and project operational information (e.g., discharge, impoundment elevation).

Finally, historical records of fish species occurrence in the project-affected areas including state agency surveys, and other information as available (e.g., surveys reported by Entergy for Vermont Yankee where publicly available)will be compared to the results of this study. The presence of invasive or introduced fish species will be noted during the analysis.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The study methodology is consistent with generally accepted practices. Previous relicensing efforts have relied on a seasonal combination of boat electrofishing and gill netting to collect baseline fisheries information (e.g., at the Yadkin Project, FERC No. 2197, and Tapoco Project, FERC No. 2169).

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of this 1-year study. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated. Study-related data will be made available to stakeholders upon written request.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This study will be conducted during the first study year (2014). Sampling locations will be identified during late 2013 and shared with the aquatics working group for consultation and approval. Prior to any fish assemblage field sampling the appropriate scientific collection permits will be obtained from both NHFG and VANR. The primary field effort associated with baseline fish assemblage sampling will be conducted during the spring (May-June), summer (July-August), and fall (September-October) seasons of 2014. It is anticipated that approximately 14 days of boat electrofishing and netting effort will be necessary to complete the number of proposed samples in the mainstem river during each season. An additional several days will be required seasonally to conduct general fisheries sampling within the Bellows Falls bypassed reach.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this study is $230,000.

REFERENCES

Binkerd, R.C., M.T. Hewlett and P.C. Downey. 1990. Vermont Yankee / Connecticut River System Analytical Bulletin 30: tag and recapture studies of smallmouth bass (*Micropterus dolomieui*, Lacepede), 1981-1989.

Downey, P.C. 1985. Vermont Yankee / Connecticut River System Analytical Bulletin 7: age and growth of smallmouth bass (*Micropterus dolomieui* Lacepede) of the Connecticut River near Vernon, Vermont.

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Normandeau. 2012. Ecological studies of the Connecticut River, Vernon Vermont. Report 41, January - December 2011, Vermont Yankee Nuclear Power Station. Report prepared for Entergy Nuclear Vermont Yankee, LLC.

Smith, R.L. 1995. Vermont Yankee / Connecticut River System Analytical Bulletin 61: Age and growth of Walleye (Stzostedion vitreum (Mitchill)) in the Connecticut River near Vernon, Vermont, 1968 to 1994.

Smith, R.L., L.L. Finck, G.R. Lescarbeau and P.C. Downey. 1995. Vermont Yankee / Connecticut River System Analytical Bulletin 59: tag and recapture of smallmouth bass (*Micropterus dolomieui* Lacepede) in the Connecticut River near Vernon, Vermont, 1990 to 1994.

VFWD (Vermont Fish and Wildlife Department). 2006. Vermont Fish and Wildlife Strategic Plan.

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REVISED STUDY 11

AMERICAN EEL SURVEY

RELEVANT STUDY REQUESTS

FWS-08; NHDES-07; NHFG-07; VANR-15; CRWC-25; TU-05

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHFG, VANR, CRWC, and TU identified potential issues related to Wilder, Bellows Falls, and Vernon Project operations on the distribution and relative abundance of American eels in mainstem habitat upstream of the project dams. In response to those requests, the goal of this study is to provide baseline data relative to the presence of American eel upstream in the project-affected areas.

The specific objectives of this study are to:

- characterize the distribution of American eel in the project impoundments, riverine sections, and the project-influenced portions of tributaries upstream of Wilder, Bellows Falls, and Vernon dams; and
- characterize the relative abundance of American eel in the project impoundments, riverine sections, and the project-influenced portions of tributaries upstream of the dams.

RELEVANT RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS

- Specific goals related to American eel including protecting, enhancing, and restoring aquatic and riparian habitats; understanding the baseline condition of eel presence within and upstream of the projects; and minimizing project effects on eel in the projects and moving up- and downstream. Goals reference the ASMFC Interstate Fishery Management Plan for American Eel (ASMFC, 2000); ASMFC Addendum II to the Fishery Management Plan for American Eel (ASMFC, 2008); and CRASC Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin (CRASC, 2005).
- General goals for relicensing including ensuring that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives; and conserving, protecting, and enhancing habitats for fish, wildlife, and plants affected by the projects.

NHDES	• State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	• American eel is a state SGCN. Specific goals including minimizing project effects on eel inhabiting the project area or moving through the area during upstream and downstream passage. Goals reference ASFMC, 2000; ASMFC, 2008; and CRASC, 2005.
	• General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference the New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).
VANR	• American eel is a state SGCN. Specific goals related to American eel including protecting, enhancing, and restoring aquatic and riparian habitats; understanding the baseline condition of eel presence within and upstream of the projects; and minimizing project effects on eel in the projects and moving up and downstream. Goals reference ASFMC, 2000; ASMFC, 2008; and CRASC, 2005.
	• State water quality standards for designated uses of Class B waters relative to levels of water quality that fully support aquatic biota and habitat.
	• General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.
	• VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety. Goals reference the Vermont Fish and Wildlife Strategic Plan (VFWD, 2006) and Vermont's Wildlife Action Plan (Kart et al., 2005).

ASSOCIATION WITH OTHER STUDIES

This study is part of a group of studies related to American eel in the project areas. Related studies include the American Eel Upstream Passage Assessment (Study 18), American Eel Downstream Passage Assessment (Study 19), and American Eel Downstream Migration Timing Assessment (Study 20). Together, these four studies will provide a more complete picture of American eel usage of the mainstem river and project areas and potential project effects.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

As described in the PADs, a limited number of American eels were collected during sampling for the Fish Assemblage and Habitat Assessment of the Upper Connecticut River study (Yoder et al., 2009). A single eel was collected from the Vernon impoundment upstream of Vernon dam. No eels were observed during sampling conducted within the Bellows Falls impoundment or upstream of Wilder dam. No eels have been collected since 2004 during Entergy's annual sampling in the vicinity of Vermont Yankee (Normandeau, 2012). However, as noted in the PAD for the Vernon Project, 262 immature American eels were documented moving upstream through the upstream fish ladder at Vernon during 2012 (Lael Will, Vermont Fish and Wildlife, personal communication). As stated in its study request, NHFG documented the presence of American eel upstream of both the Bellows Falls and Wilder dams.

Although evidence exists that American eels are moving upstream of the Vernon, Bellows Falls, and Wilder dams, the distribution and relative abundance of American eels in the mainstem habitat upstream and in the project areas remains unknown. The results of this study will help to characterize the presence of eels above project dams and may inform prescriptions for potential downstream passage requirements in the new licenses.

PROJECT NEXUS

If eels are accessing and using habitat upstream of the projects in numbers sufficient to maintain species success and repopulation in those areas, then current species distribution and abundance data are important to collect. When coupled with timing and route-specific survival estimates for outmigrating silver eels (Study 19), the distribution and relative abundance data collected for this study can help to identify the critical population sizes in each project area that might trigger the need for downstream eel passage.

STUDY AREA AND STUDY SITES

Surveys will be conducted for the presence and relative abundance of American eels in the project waters upstream of each dam from the upper extent of Wilder impoundment downstream to Vernon dam. This approximately 120-mile reach of the Connecticut River has been divided into five mainstem strata:

- Wilder impoundment (RM 262.4 - 217.4;)
- Wilder downstream riverine corridor (RM 217.4 – 199.7);
- Bellows Falls impoundment (RM 199.7 – 173.7);
- Bellows Falls downstream riverine corridor (RM 173.7 – 167.9); and
- Vernon impoundment (RM 167.9 – 141.9).

Proposed mainstem strata have been delineated based on a combination of general river morphology and project structures. Each mainstem stratum will be delineated in 500-meter segments using ArcGIS. Within each mainstem strata, 500-meter segments will be randomly selected for eel sampling. The total number of randomly selected segments within a mainstem stratum will be proportional to the contribution of the total length of that stratum to the entire study reach. A total of 37 shoreline segments will be randomly selected in the Wilder impoundment, 15 in the riverine section downstream of Wilder, 22 in the Bellows Falls impoundment, 5 in the riverine section downstream of Bellows Falls, and 22 within the Vernon impoundment. For each shoreline transect, the bank to be electrofished (east or west) will be randomly selected prior to sampling.

In addition to sampling in the five mainstem strata, surveys for the presence and abundance of American eel will also occur in tributary habitat within the limits of the project-influenced area upstream of each dam. As part of a preliminary ArcGIS assessment, a total of 112 perennial tributaries have been identified entering the project area upstream of Wilder dam (n = 34), Bellows Falls dam (n = 41), and Vernon dam (n=37). A total of 24 tributaries will be selected for eel sampling in a manner proportional to the total. A total of 7 tributaries will be selected upstream of Wilder, 9 upstream of Bellows Falls, and 8 upstream of Vernon. TransCanada will consult with the working group prior to the final tributary sampling design to ensure that tributaries with the highest interest are selected with the remaining number randomly selected. Sampling within the selected tributaries will occur over a 500-meter distance or the full length of the project-affected reach, if a 500-meter reach is not available.

The Bellows Falls bypassed reach will be sampled for eels as part of the American eel upstream passage assessment (Study 18).

Study requests also asked that the survey area for eel sampling upstream of each dam include lakes and ponds associated with tributaries (including, but not limited to, Spofford Lake and Lake Morey). These areas are outside of the FERC-designated project areas, however, and have no nexus with project operations; therefore, these areas are not included in this study.

METHODS

Sampling techniques for this 1-year assessment of American eel distribution and relative abundance upstream of the projects are as presented in the study requests and include electrofishing and eel traps.

Electrofish Surveys

American eel surveys within the five mainstem strata will be conducted using a boat-mounted Smith-Root electrofishing system. Should the field crew be unable to sample a particular segment due to either safety or access issues, a randomly selected alternative location will be chosen. American eel surveys within the selected project-influenced tributary locations will be conducted by electrofishing. Should water depths prevent the use of a boat mounted unit, a barge-mounted unit will be supplemented. Sampling will occur during the evening and night hours (6:00 PM to midnight) when American eel are most active.

Each mainstem and project-influenced tributary location will be sampled one time, and sampling will consist of a single pass along the shoreline and in an upstream direction. Scap netters on the bow of the electrofish boat or alongside the barge will net and place stunned eels in an onboard live well for processing once the full length of the transect is complete. Any eels observed during electrofish sampling but not netted will be noted on the field data sheet for that particular sample. Non-target fish species will not be collected.

Following completion of the electrofishing sample, biological data will be collected from captured eels. Each eel will be assigned a length class (0 to 6 inches, 6 to 12 inches, 12 to 18 inches, >18 inches). The first 10 individuals within each length class will be individually measured for total length and wet weight. Additional eels within a particular length class will be enumerated, and a batch weight will be recorded. In addition to length and weight, the first 10 individual eels in the >18-inch length class will also have eye diameter measurements recorded. To facilitate collection of length and weight data as well as prevent unnecessary injuries to the eels, it may be necessary to anesthetize individuals using an appropriate anesthetic for the species (i.e., ice, clove oil, MS-222). Each eel will be marked in an effort to identify individuals who may have already been captured to avoid overestimating eel abundance. Any recaptures will be recorded. Eels will be marked using either a combination of clips to the dorsal and/or anal fins or by visual implant elastomer tags which have been shown to have no significant impacts to growth or mortality in the closely related European eel (Simon and Dorner, 2011). Following processing, and after full recovery from anesthesia, if used, all eels will be returned to the river.

The date, start and end time, sample effort (i.e., seconds fished) water quality (temperature, DO, pH, conductivity, and turbidity), weather, cloud cover and dominant substrate will be recorded for each 500-meter shoreline transect.

Eel Traps

Eel trap stations will be established at a suitable location at each mainstem and project-influenced tributary location randomly selected for electrofishing. Should any strata be non-conducive to electrofish sampling, assessment for the distribution and relative abundance of eels will rely solely on eel traps. Eel traps will consist of standard double-entry, galvanized wire mesh cylinders approximately 2.5 feet long. Eel traps will be weighted to remain on station for the duration of their soak time and will be retrievable via a float line. Traps will be baited using dead herring or other appropriate bait (e.g., chicken liver, cat food, canned fish). At the time of deployment, field crews will record the coordinates for the sampling location as well as the set date and time. Traps will be checked after approximately 24 hours of soak time.

Eel trap catch will be processed identically to catch for electrofish samples. All eels will be assigned a length class and enumerated. A subset of eels will be measured for length and weight to provide a representative sample of individuals from each length class represented in the total catch. Similar to eels captured by electrofish sampling, each eel collected in an eel pot will be marked in an effort to identify individuals who may have already been captured to avoid overestimating eel abundance. The set, check, and pull dates and times, water quality (temperature, DO, pH, conductivity, and turbidity), weather, cloud cover, water depth, and dominant substrate will be recorded for each sample.

ANALYSIS

Results of this study will be presented in graphical and tabular format. Species distribution data will be displayed on maps of the sampled study areas. Abundance data, in the form of raw catch and CPUE will be presented in tabular format. Length frequency data will be presented graphically. Occurrence of silver eels (as indicated by eye diameter measurements) will be presented in tabular format.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The study methodology is consistent with generally accepted practices. Previously conducted (Saluda Hydroelectric Project, FERC No. 516) and active (Eastman Falls Hydroelectric Project, FERC No. 2457) relicensing efforts have relied on a similar combination of electrofish and eel trap sampling for the purposes of describing eel distribution and relative abundance in hydroelectric project areas.

DELIVERABLES

A report will be prepared that presents methods, analysis and results of the study. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

The field effort associated this study will be conducted during the summer months (July-September) of the first study year (2014). It is anticipated that approximately 20 nights of electrofishing will be necessary to survey all shoreline transects and project-influenced tributary locations. Total sampling time for each eel pot will be 24 hours, and the total number of days required to deploy and fish each station will depend on the number of eel traps available.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this study is $115,000.

REFERENCES

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Simon, J. and H. Dorner. 2011. Growth, mortality, and tag retention of small *Anguilla anguilla* marked with visible implant elastomer tags and coded wire tags under laboratory conditions. Journal of Applied Ichthyology 27: 94-99.

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Yoder, C.O., L.E. Hersha, and B. Appel. 2009. Fish Assemblage and Habitat Assessment of the Upper Connecticut River: A Preliminary Result and Data Presentation. Final Project Report. Submitted to: U.S. Environmental Protection Agency, Region 1, Boston, MA. Center for Applied Bioassessment & Biocriteria, Midwest Biodiversity Institute, Columbus, OH.

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REVISED STUDY 12

TESSELLATED DARTER SURVEY

RELEVANT STUDY REQUESTS

FWS-14; NHDES-23; NHFG-23; VANR-16; CRWC-31; TNC-06

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHFG, VANR, CRWC, and TNC indicated that Wilder, Bellows Falls, and Vernon Project operations may affect the distribution and abundance of the tessellated darter within project-affected areas. The goal of the study requests is to assess the effects of project operations on populations of tessellated darter, a New Hampshire SGCN and known host species for the federally listed as endangered dwarf wedgemussel (DWM).

TransCanada's specific objective for this study is to characterize the distribution and relative abundance of tessellated darter within project-affected areas. With this information, some judgments on whether the DWM population is constrained due to distribution and abundance of tessellated darters may be feasible.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS

- Tessellated darter is one of three host species in the Connecticut River for the gloclidia of DWM, a federally listed endangered species. The goal for DWM is species recovery for removal under the Endangered Species Act in accordance with the FWS Dwarf Wedgemussel Recovery Plan (FWS, 1993) and Five Year Review Summary and Evaluation (FWS, 2007).
- General goals for relicensing including ensuring that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives; and conserving, protecting, and enhancing habitats for fish, wildlife, and plants affected by the projects.
- General goals related to aquatic resources including, protecting, enhancing, and conserving aquatic and riparian habitats; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.

NHDES

- State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.

NHFG

- Tessellated darter is a state SGCN.
- General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference the New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR

- Tessellated darter is a state SGCN.
- State water quality standards for designated uses of Class B waters relative to levels of water quality that fully support aquatic biota and habitat.
- General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.
- VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them; and providing fish- and wildlife-based activities including viewing, harvesting, and utilization of fish, plant, and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005).
- VFWD general goals related to resource conservation, fish, and wildlife recreation and use, and human health and safety.
- Goals reference the Vermont Fish and Wildlife Strategic Plan (VFWD, 2006).

ASSOCIATION WITH OTHER STUDIES

Information collected during the Aquatic Habitat Mapping (Study 7) will be used to characterize habitat conditions at each unique sample collection location and may provide insight into species distribution and abundance. Likewise, areas targeted as most likely to provide appropriate habitat for DWM (Study 24) and incidental observations of tessellated darter during that study will aid in the location of sampling efforts to characterize the distribution and relative abundance of tessellated darter within the project-affected areas.

Information collected on the presence and relative abundance of small-bodied benthic fish species during this study will be used to augment findings related to the determination of the baseline fish assemblages (Study 10). Where habitat and sampling gears are appropriate (e.g., backpack electrofish sampling in the Bellows Falls bypassed reach), sampling for both resident fish spawning studies (Study 13, 15) will be conducted concurrently.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

As described in the PADs, the tessellated darter is a confirmed host for DWM (a federally listed as endangered freshwater mussel species) resident within the upper Connecticut River. As noted in the study requests, existing literature indicates that tessellated darters may be found in a variety of habitat types (Scott and Crossman, 1979; Hartel et al., 2002). Although tessellated darter has been confirmed both upstream and downstream of each project, previous fisheries sampling in those areas did not rely on collection techniques that specifically target small-bodied benthic fish species. Based on comments in the study requests, the resource agencies determined it is likely that results from previous investigations are biased and may have underrepresented the abundance.

PROJECT NEXUS

Operations at the Wilder, Bellows Falls, and Vernon Projects potentially affect the availability of instream habitat on which the tessellated darter and other lotic species depend. Habitat for tessellated darters may be related to the project operations in terms of flow (water depth and velocity, and their timing, duration, frequency, and rate of change), as well as the interactions of flow with other habitat variables such as substrate, vegetation, and cover. Operations both upstream (i.e., impoundment levels) and downstream (i.e., flow fluctuations) may affect habitat, which may consequently lead to changes in the distribution, abundance, and behavior of tessellated darter. Those changes could, in turn, potentially affect the federally listed as endangered DWM.

Results from this study will enhance the currently limited knowledge related to the distribution and relative abundance of tessellated darter in the project areas.

STUDY AREA AND STUDY SITES

The study area will encompass the upper extent of the Wilder impoundment to the Vernon tailrace. For sampling purposes, that portion of the Connecticut River has been initially divided into six geographic reaches delineated based on a combination of general river morphology and project structures. These geographic reaches are as follows:

- Wilder impoundment (RM 262.4 - 217.4);
- Wilder tailrace and downstream riverine corridor (RM 217.4 – 199.7);
- Bellows Falls impoundment (RM 199.7 – 173.7);
- Bellows Falls tailrace and downstream riverine corridor (RM 173.7 – 167.9);

- Vernon impoundment (RM 167.9 – 141.9); and
- Vernon tailrace (RM 141.9 - 140.4).

Following review of the aquatic habitat mapping (Study 7), each geographic reach will be stratified based on habitat characteristics. The total number of sampling locations within each geographic reach will be randomly placed proportional to habitat type frequency (e.g., if 50 percent of a particular geographic reach is deep-water impounded habitat than 50 percent of the total number of sampling locations proposed for that geographic reach would be randomly placed within that habitat type). Each stratum will be delineated in 500-meter segments using ArcGIS. Within the three strata representing project impoundments, a total of 30 randomly selected segments will be selected, and the total number within any one stratum will be proportional to the contribution of the total length of that impoundment to the entire impounded area. A total of 14 segments will be randomly selected in the Wilder impoundment, 8 in the Bellows Falls impoundment, and 8 within the Vernon impoundment. Within the three strata representing tailrace and riverine sections, a total of 15 randomly selected segments will be selected, and the total number within any one stratum will be approximately proportional to the contribution of the total length of that segment to the entire tailrace or riverine area. A total of 8 segments will be randomly selected in the Wilder tailrace and downstream riverine corridor, 4 in the Bellows Falls tailrace and downstream riverine corridor, and 3 within the Vernon tailrace.

METHODS

Given the large sampling area (approximately 120 river miles) and complex habitat diversity, the selection of a single gear type to effectively sample all randomly selected locations while also providing a defensible characterization of the distribution and relative abundance of tessellated darters is unrealistic. Selection of a single sampling gear would prevent sampling of tessellated darters from a variety of habitat types and would likely result in a poor understanding of their distribution in the project affected areas. However, prior to any sampling, appropriate methodologies will be identified for each stratum (i.e., habitat type), and those methodologies will be consistently used over all geographic reaches to avoid gear bias for within-habitat type comparisons.

Collection techniques for tessellated darters were not specified in the study requests. Available peer-reviewed and gray literature dealing with the collection of small-bodied benthic fish species was reviewed, and two appropriate sampling techniques were identified: 1) visual surveys using snorkel/SCUBA; and 2) beach seine/backpack electrofish unit. A third methodology, an electrified benthic trawl, was also considered but was excluded due to concerns over potential impacts to the DWM that might have constituted a taking; triggering Section 7 ESA consultation.

Visual Surveys

Visual surveys conducted by snorkel or SCUBA will be used for sampling within all strata (i.e., habitat types) characterized by non-wadeable water depths. Within each 500-m segment, a total of 3 visual survey sample areas will be randomly placed. Each visual survey sample area will consist of 5 fixed-radius count locations spaced evenly across the channel (i.e., west bank, 1/3rd channel width, channel midpoint, 2/3rd channel width, east bank). Coordinates and basic water quality parameters (temperature, DO, pH, conductivity, and turbidity) will be recorded at each of sampling location. Sampling will consist of dropping a weighted line at each count location. A diver will descend down the line and quantify fish and available habitat within a 3-m radius of the weighted center point. Specifically, water depth, percent composition of substrate types, percent cover and estimated height of aquatic vegetation, percent cover of coarse wood debris will be recorded. A visual estimate of flow velocity will also be assessed and recorded. A total count of tessellated darters within each 3-m count location will be recorded along with the relative proportion of adult and juvenile darters.

Tessellated darters can be extremely abundant in portions of the Connecticut River and in those cases, obtaining an accurate count of individuals over a large area can be very difficult (E. Nadeau, personal communication). In situations where that is the case, an index of abundance (e.g., estimated number per square ¼ m) will be recorded, rather than a precise count for the entire count location. Effort will be made during snorkel/SCUBA sampling to record the presence and abundance of DWM and the presence of other freshwater mussel species.

The fixed-radius count approach (similar to quadrat or plot studies) employed here will narrow the sample area down to a size that can be better characterized by specific parameters and allow for a more precise fish count that can be related to the measured habitat parameters. This approach lends itself to more robust analysis using ANOVA or linear/multiple regression, enabling a better overall understanding of distribution and habitat preference of the darters.

Beach Seine / Backpack Electrofish

Beach seine/backpack electrofish sampling will be used for sampling within all strata (i.e., habitat types) featuring shallow, wadeable water depths. Should the field crew be unable to sample a particular segment due to either safety or access issues, a randomly selected alternative location within the same habitat type will be chosen. Beach seine/backpack electrofish sampling will be conducted by anchoring a fine mesh seine at the downstream end of the sample station. A backpack electrofish unit and 2 to 3 biologists will move in a downstream direction towards the seine while actively kicking the substrate to drive stunned individuals towards the collection net. Sampling will take place during the daylight hours. We will not conduct electroshocking in areas where DWM are known or possibly likely to occur during the March to mid-Jun period as requested by FWS, and the study schedule does not anticipate such sampling until late summer. Three equal-length transects will be randomly placed and sampled within each 500-m segment. Field crews will record the start and end coordinates for each beach seine/backpack electrofish sample. In addition, the date, start and end time, water depth, velocity, water quality (temperature, DO, pH, conductivity and turbidity), weather, and dominant substrate will be recorded. Factors such as percent composition of substrate types, percent cover and estimated height of aquatic vegetation and percent cover of coarse wood debris will also be recorded for shallow water samples. Effort will be made during the shallow water sample collections to record the presence and abundance of DWM and the presence of other freshwater mussel species.

Total catch will be identified to species and enumerated. Tessellated darters will be measured for total length. Representative photographs will be taken of each collected fish species.

ANALYSIS

Results of this study will be presented in graphical and tabular format and combined into a single report document with the results from the Fish Assemblage Study (Study 10). For each sample collected, date and time of sample, the specific location (coordinates), sampling effort and unique habitat and environmental variables at the time of collection will be presented in tabular format and in GIS attribute tables. Distribution data will be displayed as GIS maps of the six sampling strata overlaid with habitat mapping from other studies, and abundance data in the form of raw catch and CPUE will be presented in tabular format within the attribute tables and or hardcopy report for each station and sample reach. The GIS layer attribute table for each tessellated darter sampling location will include information on the length frequency data for tessellated darters at that location as well as operational and environmental conditions at the time of sampling.

An examination of the distribution and relative abundance of tessellated darters as it spatially relates to the distribution and relative abundance of DWM (from Study 24) will be conducted in GIS, and results will be presented in the report.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The study methodology is consistent with generally accepted practices. Previous relicensing efforts (e.g., at the Conowingo Project [FERC No. 405]) have relied on a similar combination of snorkel/SCUBA visual surveys and beach seine/backpack electrofishing sampling to describe the presence of benthic darter species.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated. Study related data will be made available to stakeholders upon written request.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This study will be conducted during the first study year (2014), following completion of aquatic habitat mapping (Study 7). Sampling locations will be identified by May 2014 and shared with the fisheries interest community for discussion and review. The primary field effort associated with tessellated darter surveys will be conducted during the late-summer months (August-September, 2014). This will ensure that young-of-year individuals are large enough to recruit to the sampling gears and be represented in collected samples. Prior to any field sampling TransCanada will obtain the appropriate scientific collection permits from both NHFG and VANR. It is anticipated that 7 to 10 days of snorkel/SCUBA sampling will be necessary to complete the number of proposed samples within the three impounded study reaches. An additional several days will be required to conduct tessellated darter sampling within the tailraces and downstream riverine corridor study reaches.

LEVEL OF EFFORT AND COST

The expected cost for survey work is $85,000.

REFERENCES

FWS (U.S. Fish and Wildlife Service). 2007. Dwarf Wedgemussel, *Alasmidonta heterodon,* 5 Year Review. Summary and Evaluation. Concord, NH.

FWS. 1993. Dwarf Wedge Mussel [sic] *Alasmidonta heterodon* Recovery Plan. Hadley, MA. 52 pp.

Hartel, K.E., D.B. Halliwell, and A.E. Launer. 2002. Inland Fishes of Massachusetts. Massachusetts Audubon Society, Lincoln, MA.

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, and B. Popp (editors). 2005. Vermont's Wildlife Action Plan. Waterbury, VT.

NHFG (New Hampshire Fish and Game Department). 1998. New Hampshire Fish and Game Department Strategic Plan (1998–2010). Concord, NH.

Scott, W.B. and E.J. Crossman. 1979. Freshwater Fishes of Canada. The Bryant Press Limited, Ottawa, Canada.

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REVISED STUDY 13

TRIBUTARY AND BACKWATER AREA FISH ACCESS AND HABITATS STUDY

RELEVANT STUDY REQUESTS

FWS-18; NHDES-17; NHFG-17; VANR-19; CRWC-19

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHFG, VANR, and CRWC identified issues related to water-level fluctuations caused by Wilder, Bellows Falls, and Vernon Project operations that may impede fish movement in and out of tributaries and backwater areas in the project impoundments and riverine reaches.

The goals of this study are to assess whether water-level fluctuations from project operations:

- impede fish movement into and out of tributaries and backwater areas within the project-affected areas; and

- affect available fish habitat and water quality in the tributaries and backwater areas within the project-affected areas.

The objectives for this study are to conduct a field study:

- of a subset of tributaries and backwaters in the project-affected areas to assess potential effects of water-level fluctuations on fish access to these areas in the impoundments and riverine reaches below the projects; and

- to examine potential effects of water-level fluctuations on available habitat and water quality in a subset of project-affected tributaries and backwaters.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS	• General goals for relicensing including ensuring that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives and conserving, protecting, and enhancing habitats for fish, wildlife, and plants affected by the projects. • General goals related to aquatic resources including protection, enhancement, or restoration of aquatic and riparian habitats; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project

		effects on water quality and aquatic habitat.
NHDES	•	State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	•	General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998) including two SGCN unidentified in the study request.
VANR	•	State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat.
	•	General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.
	•	VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them; and providing fish and wildlife-based activities including viewing, harvesting, and utilization of fish, plant and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005).
	•	VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety.
	•	Goals reference Vermont Fish and Wildlife Strategic Plan (VFWD, 2006), including fish SGCN.

ASSOCIATION WITH OTHER STUDIES

This study depends on the results of the Aquatic Habitat Mapping Study (Study 7). The bathymetry data from that study will help identify tributaries and backwaters in project impoundments that may have access problems, such as shallow areas in the inlets to backwaters or shallow areas in and around tributary mouths that may impede fish movements in and out of these areas when water levels are low. For the riverine reaches, preliminary data will be collected in Study 7 on the tributaries and backwaters, including data to identify those reaches that may be affected by project-related fluctuating water levels. These data will help in identifying potential tributaries and backwaters for further investigation in this study.

Concurrent studies that will provide additional data are the Instream Flow Study (Study 9), Hydraulic Modeling Study (Study 4), and Operations Modeling Study (Study 5). Those studies will provide water-level elevation data that can be incorporated into this study's analysis through the operations model.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

All study requestors stated that to their knowledge, no information exists related to effects on tributary and backwater area access and habitat due to project operations.

PROJECT NEXUS

In their study requests, stakeholders expressed concern that water-level fluctuations due to project operations have the potential to create conditions that could impede the movement of fish between the Connecticut River and its tributaries and backwaters. These conditions, if present, could limit access to spawning habitat and growth opportunities. Additionally, project-related, water-level changes have the potential to alter water quality and quantity in these areas, which could decrease productivity.

STUDY AREA AND STUDY SITES

The study area includes all tributaries and backwaters from the upper extent of the Wilder impoundment to approximately 1.5 miles below Vernon dam and up to a point in tributaries and backwaters where project operations no longer have any effect under normal operating conditions.

METHODS

During aquatic habitat mapping of riverine reaches and bathymetry and habitat mapping of the impoundments conducted under Study 7, tributaries and backwater areas in project-affected areas will be inspected, and preliminary data collected to assess their potential for impeding fish movements during fluctuating water levels. These preliminary data will be collected during the summer of 2013 (July–September). The inlets to backwaters and tributary mouths will be photographed, and water depth at selected points will be collected to gather baseline data on the depth of the inlets to backwater areas and tributaries. Backwater sites and tributary mouths that have shallow inlets and shoal areas with the greatest chance of impeding fish movement during fluctuating water levels will be documented. Perched culverts within project-affected areas will also be examined and documented with a primary focus in this study on those in backwater areas. Culverts in project-affected sections tributaries will also be examined during other parts of the year in the associated fish spawning and assemblage studies.

Water-level recorders placed at selected sites in Study 7 during the summer of 2013 will be used to collect preliminary data on the extent of water-level fluctuations in these areas. These preliminary data will be used to make the final selection of a subset of tributary and backwater sites that are most likely to impede fish movement (e.g., 1 foot or less water depth during low impoundment water levels) and will be the focus of field efforts in 2014 to assess project effects on habitat, water quality, and access. Not all sites with 1 foot or less of depth will impede fish passage, and additional criteria including length of the shallow water zone, available cover, and sites with depths less than 6 inches will be evaluated for final site selection in consultation with the aquatics working group.

During the study year (2014), the selected sites will be studied further. Water-level recorders will be placed in a random subset of applicable backwaters and tributary areas and will collect hourly depth changes and 15-minute water temperature data. Additional water quality data will be collected (temperature, DO, pH, conductivity, and turbidity) at the subset of sites ultimately selected for additional evaluation in this study with those sites based on the results of Study 7 and in consultation with the aquatics working group.

When low-flow measurements are being collected for the Instream Flow Study (Study 9), these selected locations will be inspected, photographed, and data collected on water depths at the backwater inlets and tributaries to document the conditions found during low flows. These areas will also be inspected during the fish spawning field work in the Resident Fish Spawning in Impoundments Study (Study 14) and the Resident Fish Spawning in Riverine Sections Study (Study 15) studies and during the Fish Assemblage Study (Study 10). Data collected at applicable tributary and backwater sites during those field efforts will include water quality data (temperature, DO, pH, conductivity and turbidity), photographs, downloading of water-level recorder data, and field notes on access conditions.

ANALYSIS

Water-level recorders will be downloaded every few weeks during spring through late fall 2014 when field crews are in the area, but they will not be kept in place during the winter months because in shallow areas, they are likely to be damaged or lost by ice movement. Water-level data will be analyzed to develop a relationship between project operations and effects at the selected sites. Bathymetry maps will be developed for areas from the main stem to the project-affected backwaters, setbacks and tributaries and will show the locations where depth recorders were installed. Using results from the Operations Model (Study 5), project-related effects on the habitat in these areas, including whether they become an impediment to fish access due to water-level fluctuations will be assessed. Water quality data collected during this study and associated studies in the selected backwaters and tributary mouths will also be analyzed to see if water fluctuations affect water quality at the study sites. This analysis will include a comparison of water quality parameters between the main stem and the backwater areas for a subset of sites selected in consultation with the aquatics working group.

Data from the water-level recorders, bathymetry mapping, habitat mapping (both riverine and impoundment), and periodic field surveys for the instream flow and resident fish spawning assessments (Studies 9, 14, and 15) will assist in determining potential effects of project operations on fish access and habitat during water-level fluctuations.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methodologies presented above are consistent with accepted scientific practice and have been used at other hydroelectric projects in the Northeast, including the Brassua Hydroelectric Project (FERC No. 2615).

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. An interim study report will be prepared after the first year of study is complete. The report will be provided to stakeholders for review and comment. A draft final study report will be prepared after the study and analysis is complete in study year 2. Stakeholder comments on the draft final report will be included in the final study report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This study will be conducted during the first study year (2014). Based on the results of the 2013 Aquatic Habitat Mapping Study (Study 7), tributary and backwater sites will be selected for detailed survey in 2014. Water-level recorders will be deployed in select locations in early spring 2014, and data will be collected at the sites selected during the related studies through spring of 2015.

LEVEL OF EFFORT AND COST

The preliminary estimated cost of this study is $70,000, including an estimated 30 Onset water-level recorders @$15,000.

REFERENCES

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, and B. Popp (editors). 2005. Vermont's Wildlife Action Plan. Waterbury, VT.

NHFG (New Hampshire Fish and Game Department). 1998. New Hampshire Fish and Game Department Strategic Plan (1998–2010). Concord, NH.

VFWD (Vermont Fish and Wildlife Department). 2006. Vermont Fish and Wildlife Strategic Plan.

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REVISED STUDY 14

RESIDENT FISH SPAWNING IN IMPOUNDMENTS STUDY

RELEVANT STUDY REQUESTS

FWS-17; NHDES-16; NHFG-16; VANR-18; CRWC-17

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHFG, VANR, and CRWC identified issues regarding the potential effects of impoundment fluctuation on resident fish spawning success in the Wilder, Bellows Falls, and Vernon Project impoundments.

The goal of this study is to assess whether project-related, water-level fluctuation in the impoundments affect resident fish spawning. The target species identified for this study by VANR, NHDES, NHFG, and CRWC include smallmouth bass, largemouth bass, yellow perch, black crappie, pumpkinseed, bluegill, chain pickerel, northern pike, golden shiner, white sucker, spottail shiner, walleye, and fallfish. FWS did not specify the fish species that should be included in the analysis.

The objectives of this study are to:

- delineate, quantitatively describe (e.g., substrate composition, vegetation type and abundance), and map shallow-water aquatic habitat types subject to inundation and exposure due to normal project operations, noting and describing additional areas where water depths at the lowest operational range are wetted to a depth less than 1 foot, such as flats, near shoal areas, and gravel bars with very slight bathymetric change;

- conduct analysis of the effects of the normal operation and the maximum licensed impoundment fluctuation range on the suitability of littoral zone habitats for all life stages of target species likely to inhabit these areas;

- conduct field studies to assess timing and location of fish spawning under existing conditions; and

- conduct field studies to assess potential effects of impoundment fluctuation on nest abandonment, spawning fish displacement, and egg dewatering.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS	• General goals for relicensing including ensuring that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives and conserving, protecting, and enhancing habitats for fish, wildlife, and plants affected by the projects. • General goals related to aquatic resources including protection, enhancement, or restoration of aquatic and riparian habitats; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.
NHDES	• State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	• General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).
VANR	• State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat. • General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat. • VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them; and providing fish and wildlife-based activities including viewing, harvesting, and utilization of fish, plant and wildlife resources. Goals reference Vermont’s Wildlife Action Plan (Kart et al., 2005). • VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety. • Goals reference Vermont Fish and Wildlife Strategic Plan (VFWD, 2006), including fish SGCN.

ASSOCIATION WITH OTHER STUDIES

The Aquatic Habitat Mapping Study (Study 7) will be completed prior to this study. Data collected in that study will be used to identify preferred spawning habitat types and depths of the targeted fish species.

Data collected concurrently about fish spawning in the riverine sections (Resident Fish Spawning in Riverine Sections, Study 15) includes some of the same fish species being investigated in the impoundments and will provide data on spawning times for walleye, smallmouth bass, fallfish, and white sucker. The Fish Assemblage Study (Study 10) will also inform this study because collections made during the spring/early summer spawning period will provide potential location data for target species spawning grounds and nesting sites for this study. The Tributary and Backwater Fish Access and Habitats Study (Study 13) will provide information on potential projects effects on spawning in those areas. The Operations Model (Study 5) will provide information on impoundment elevations and project flows in relation to identified impoundment spawning habitat.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

All five requestors stated that, to their knowledge, no information exists related to the effects of project operations on resident fish spawning. This study, in conjunction with the referenced related studies, will provide information on resident fish spawning activity in relationship to project operations.

PROJECT NEXUS

Project operations, specifically fluctuating water levels in the three impoundments, have the potential to affect fish spawning success and spawning habitat quality and quantity. The potential exists for either fish eggs or quality spawning habitat to be dewatered, and/or for some species of fish to abandon nests containing eggs. Data collected during this study will assist in assessing whether fluctuating water levels from project operations affect spawning fish in the project impoundments.

STUDY AREA AND STUDY SITES

The study area includes all impounded waters of the Wilder, Bellows Falls, and Vernon Projects, including portions of tributaries and backwaters within the impoundments that are affected by project operations.

METHODS

To effectively delineate and map the shallow-water habitat types and analyze the potential effects of fluctuating water levels on these areas, detailed bathymetry and side-scan sonar habitat mapping from the Aquatic Habitat Mapping Study (Study 7) will need to be conducted before this study can begin. The bathymetry mapping will be used to identify shallow-water habitats that project-related fluctuating water levels in the impoundments may be affect. The side-scan sonar habitat mapping will provide the habitat types that occur in all three impoundments, including substrate types (sand/mud, gravel/cobble, boulder, and riprap), woody cover, and submerged vegetation. The habitat mapping will be post-processed to delineate and quantify the amount of the different habitat types found in each impoundment and the depths in which they occur. The substrate types and locations will assist in identifying potential target fish spawning locations based on spawning habitat preferences, such as gravel or cobble areas. These data will help focus the field effort for this study to locate fish spawning sites based on habitat characteristics such as substrate and depth. State fisheries agencies will also be consulted regarding specific locations to target for monitoring, based on their knowledge of the Connecticut River.

Water levels in each of the impoundments during normal operations will be quantified using Onset HOBO water-level data loggers (vertical accuracy of +/- 0.1 inch). Data loggers will be placed in selected locations along the length of each impoundment, including backwater areas, potential spawning locations, shoal areas, and other sensitive locations to determine how, in terms of depth, frequency and duration, daily water-level changes affect these locations. The data loggers will also collect water temperature data every 15 minutes, and field crews will download the data anytime they are in the area sampling or checking on the nest sites, which will approximately twice per week at the spawning sites. Data will be compiled with corresponding project operational data from the downstream dam to create a dataset that can be used to analyze how project operations affect the spawning areas primarily in terms of elevation, frequency, and duration.

A literature review of spawning times, temperature, and habitat preferences with geographic relevance for the target fish species will be conducted. A field study will be conducted in each impoundment during each target species' spawning season to locate shallow-water spawning areas and record spawning times for the target species. Five of the 13 target fish species—walleye, yellow perch, white suckers, northern pike, and chain pickerel—spawn in the early spring when water temperatures are approximately 5.6 to 11.1°C. None of these fish are nest builders (they broadcast their eggs), but they prefer specific habitat types for spawning, and this will help in locating their spawn sites. For instance, northern pike and chain pickerel require vegetated areas for spawning, so searches will focus on submerged aquatic beds in shoal water. Yellow perch spawn near rooted vegetation but also like to spawn near submerged brush, fallen trees, and sometimes over sand and gravel areas. Walleye spawn in rocky areas in white water, so they are not expected to spawn in the impoundments. However, they could move up to the tailraces (riverine habitat) or in the tributaries in faster water. Walleye egg traps will be set in the tailraces of the projects to locate their spawning sites; that effort is detailed in the Resident Fish Spawning in Riverine Sections Study (Study 15).

Additional egg traps will be set in tributaries that enter the three impoundments, if they have the right conditions (e.g., moderate to high current with a rocky bottom), to determine whether walleye are spawning in those sites. Egg traps will be constructed of standard 8-inch x 16-inch concrete blocks wrapped in hog's hair synthetic filter media that forms an ideal surface to collect the broadcasted white sucker and walleye eggs. Four individually wrapped blocks will be attached at equally spaced intervals (5 to 10 feet) along a line and a buoy will be connected to one end. Egg traps will be set in the proper habitat in some of the lower tributaries (which are influenced by project operations) in an attempt to locate white sucker spawning sites. White sucker typically move into tributary streams to spawn in shallow water with a gravel bottom, but sometimes they spawn in rapids. Using the habitat and bathymetry data collected from the Aquatic Habitat Mapping Study (Study 7), these preferred habitat types can be identified before going into the field, enabling the field crew to focus their efforts in the correct habitats. The time of spawning can also be narrowed down using literature-based water temperature preferences for each fish species. Field efforts to look for spawning sites for the five species listed above will begin in April and will likely be completed by early May (dependent upon water temperatures).

The other eight target fish species (smallmouth bass, largemouth bass, pumpkinseed, black crappie, bluegill, spottail shiner, fallfish, and golden shiner) spawn later in the season when water temperatures range from 61 to 68^{o}F (late spring/early summer). Most of these fish build nests and guard the eggs, except golden shiner and spottail shiner, which scatter their eggs. The preferred habitats, depth, and temperature ranges of these fish will be used to locate the spawning sites/nests.

Sampling during the Fish Assemblage Study (Study 10) will assist with locating spawning sites and nest locations. Fish in spawning condition will be reported by the field crew and all nest/spawning sites will be recorded with GPS. Sampling for the early spawners (April) will be conducted prior to the general fisheries surveys. This early sampling will include electrofishing in key habitat areas, such as off-channel locations for chain pickerel, yellow perch, and northern pike and in the tributary mouths for walleye and white suckers. Captured fish will be checked for spawning condition, released back to the water and their locations recorded with GPS. If targeted fish are found and they are spawning, a water-level recorder will be set up to document water levels in the spawning site to record depth and water temperature every 15 minutes. These data will determine if the area is dewatered during the spawning period, and if so, the time that it occurred, so it can be assessed whether the fluctuating water levels may have been due to project operations. Data on the depth of the nesting site, fish species, water quality data (temperature, DO, pH, conductivity, and turbidity) and habitat type (e.g., aquatic weed bed or gravel bar) will be recorded.

Field crews will return to the spawning sites during the spawning season to conduct visual observations on the spawning nests/sites and record instances of abandoned or dewatered nests. Subsampling of fish nests after eggs hatch and larvae disperse will be conducted to assess the amount of silt, sediment, and scour observed in the nests. A subsample of abandoned nests identified during the study will also be included in this assessment.

ANALYSIS

Using data from the Aquatic Habitat Mapping Study (Study 7), water-level recorders, and field surveys, an analysis of the effects of project operations on the spawning of target resident fish species will be conducted. Analysis of the data on fish spawning sites and fish species located during the field study and potential effects that may have resulted from project operations, such as dewatered nests or spawning sites from peaking operations will be conducted. This will be performed using the outputs from the Hydraulic Modeling and Operations Modeling studies (Study 4 and 5) in order to assess the full range of current project operating conditions.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methodologies presented above are consistent with accepted scientific practice and have been used at other hydroelectric projects in the Northeast, including the Brassua Hydroelectric Project (FERC No. 2615). The side-scan sonar habitat mapping will follow the methods and analysis techniques developed by Kaeser and Litts (2010).

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. Given the similarity between studies, results for this study will be combined into a single report along with results from the Resident Fish Spawning in Riverine Sections Study (Study 15) to provide a more complete picture of the potential project impacts on resident fish spawning. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

The study will be conducted in the first study year (2014). Field work to locate spawning fish in the impoundments will be begin in late March/April 2014 and will continue into the summer until all targeted fish being surveyed have completed spawning. The water-level recorder data will be analyzed and correlated with project operations to assess whether effects on surveyed spawning fish were due to fluctuating water levels in the impoundments.

LEVEL OF EFFORT AND COST

This preliminary estimated cost for this study is $80,000.

REFERENCES

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, and B. Popp (editors). 2005. Vermont's Wildlife Action Plan. Waterbury, VT.

Kaeser, A. and T. Litts. 2010. A Novel Technique for Mapping Habitat in Navigable Streams using Low Cost Side Scan Sonar. Fisheries 35:4.

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REVISED STUDY 15

RESIDENT FISH SPAWNING IN RIVERINE SECTIONS STUDY

RELEVANT STUDY REQUESTS

NHDES-11; NHFG-11; VANR-14; CRWC-18

STUDY GOALS AND OBJECTIVES

In their study requests, NHDES, NHFG, VANR, and CRWC identified issues related to potential effects of water-level fluctuations on resident fish spawning in downstream riverine reaches of the Wilder, Bellows Falls, and Vernon Projects.

The goal of this study is to assess whether project-related, water-level fluctuations in the affected areas downstream of Wilder, Bellows Falls, and Vernon dams negatively affect resident fish spawning.

Based on the study requests, the resident target species included in this analysis are smallmouth bass, white sucker, walleye, and fallfish.

Objectives for this study are to:

- conduct field studies in the project-affected areas downstream of the Wilder, Bellows Falls, and Vernon dams to locate and map nesting locations and spawning sites; and
- conduct field studies in the project-affected areas below Wilder, Bellows Falls, and Vernon dams to assess potential effects of operational flows and water-level fluctuations on nest abandonment, spawning fish displacement, and egg dewatering.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

NHDES	• State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	• General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR	•	State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat.
	•	General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.
	•	VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety. Goals reference Vermont Fish and Wildlife Strategic Plan (VFWD, 2006), including fish SGCN.

ASSOCIATION WITH OTHER STUDIES

Aquatic Habitat Mapping (Study 7), a prerequisite study that should be completed prior to beginning this study, is anticipated to be completed in 2013. The riverine habitat mapping that is included in Study 7 for the reaches below the Wilder, Bellows Falls, and Vernon Projects (for the purpose of this study plan, referred to as the projects) will assist in identifying and focusing the field efforts on potential spawning locations that may be used by the four target fish species. The Fish Assemblage Study (Study 10) is associated with this study because the electrofishing field work in the riverine reaches in that study will be used to help locate spawning smallmouth bass and fallfish nest sites; it will not help locate walleye and white sucker spawning locations since they spawn early, prior to the electrofishing surveys.

Data collected concurrently on fish spawning in the project impoundments (Resident Fish Spawning in Impoundments, Study 14) includes some of the same fish species being investigated in the riverine sections. Study 14 will provide data on impoundment spawning times for 13 resident fish species including the four assessed in this study. The Operations Model (Study 5) will provide information on project flows in relationship to identified spawning habitat.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

All four requestors stated that to their knowledge, no information exists related to the effects of the project-related, water-level fluctuations on spawning fish downstream of the projects. This study, in conjunction with the referenced related studies, will provide information on resident fish spawning activity in relationship to project-related, water-level fluctuations.

PROJECT NEXUS

Project-related, water-level fluctuations downstream of the projects have the potential to affect resident fish spawning success and spawning habitat quality and quantity. Fish eggs or quality spawning habitat could potentially be dewatered, and/or some species of fish could abandon nests containing eggs. Data collected during this study will assist in determining whether fluctuating water levels from project operations affect fish spawning downstream of the Wilder, Bellows Falls, and Vernon Projects.

STUDY AREA AND STUDY SITES

The study area includes locations in the project-affected riverine areas downstream of the Wilder and Bellows Falls Projects and approximately 1.5 miles downstream of Vernon dam where the target fish species are likely to spawn.

METHODS

Data from the Aquatic Habitat Mapping Study (Study 7) will be analyzed to identify possible spawning sites for walleye, white sucker, fallfish, and smallmouth bass. If identified as representing a significant portion of the riverine fish communities during the fish assemblage study (Study 10), the spawning success of additional fish, such as longnose dace and trout, may also be monitored. A literature search and field surveys will be conducted to assess timing and location of fish spawning for the target species downstream of each project. State fisheries agencies will also be consulted regarding specific locations to target for monitoring, based on their knowledge of the Connecticut River.

Egg traps will be deployed to assist in the identification of spawning sites for walleye and white sucker, two riverine fish species that broadcast spawn their eggs. Egg traps will be constructed of standard 8-inch x 16-inch concrete blocks wrapped in hog's hair synthetic filter media that forms an ideal surface to collect the broadcasted white sucker and walleye eggs. Four individually wrapped blocks will be attached at equally spaced intervals (5 to 10 feet) along a line and a buoy will be connected to one end. Both species generally spawn at night in moderate to high currents over rocky substrates during the early spring when high flows and turbidity can make it difficult to locate them visually.

Temperature will drive the timing of the initial egg trap deployment; a range of 7 to 10^{o}C will be targeted because it represents the onset of the spawning period for walleye and white sucker. Egg traps will be deployed downstream of areas with suitable substrate (as identified during the Aquatic Habitat Mapping Study, Study 7) and flow velocities for both species. Traps will be checked every 48 to 72 hours, and eggs will be collected and preserved for identification in the laboratory. Once spawning locations (walleye and white sucker) are identified and confirmed through egg trap catches, the egg traps will be removed and field surveys will be conducted in those spawning areas.

Field surveys will be conducted to assess effects of water fluctuations on potential spawning fish displacement and egg dewatering. Following the detection of walleye and/or white sucker eggs, an Onset HOBO water-level data logger (vertical accuracy of +/- 0.1 inch) will be deployed at selected spawning areas to monitor water levels during the period of egg development (approximately 3 weeks). The number of monitored spawning areas will depend on the total number of areas identified during the initial egg trap sampling. Shallow-water shoal habitat where white sucker and walleye eggs are detected will be given priority over deeper water areas because it is more likely that potential impacts from project operations will be observed there. Water-level data loggers will be programmed to record water depth and temperature at 15-minute intervals. In addition to the continuously operating water-level data loggers, identified spawning locations will be visited once every 1 to 3 days. During site visits, the identified spawning locations will be photographed and water quality data (DO, pH, conductivity, and turbidity) will be recorded.

For the two nesting species, smallmouth bass and fallfish, nest sites will be located during targeted field surveys and during the electrofishing surveys conducted under the Fish Assemblage Study (Study 10). Nest locations for both species will be georeferenced using GPS. Similar to field surveys conducted for walleye and white sucker, detailed assessment of riverine conditions will be conducted at selected nesting sites during the spawning season to determine if fluctuating water levels cause nests to become dewatered. Onset HOBO water-level data loggers (vertical accuracy of +/- 0.1 inch) will be deployed at selected nesting areas to monitor water levels during the period of egg development (approximately 2 weeks). The number of monitored nesting areas will depend on the total number of areas identified during the initial survey work. Areas with multiple nests in shallow-water areas will be given priority over deeper-water nests because it is more likely that potential impacts from project operations will be observed there. Water-level data loggers will be programmed to record water depth and temperature at 15-minute intervals. In addition to the continuously operating water-level data loggers, identified nesting locations will be visited once every 1 to 3 days. During site visits, the identified nesting locations will be photographed and water quality data (DO, pH, conductivity, and turbidity) will be recorded.

Subsampling of fish nests after eggs hatch and larvae disperse will also be conducted to assess the amount of silt, sediment, and scour in the nests. A subsample of abandoned nests identified during the study will also be included in this assessment.

ANALYSIS

Data on the timing and location of fish spawning collected during field efforts will be summarized. The potential effects of project-related, water-level fluctuations on nesting and spawning fish, such as nest abandonment, egg dewatering, and spawning fish displacement, will be analyzed. This analysis will include comparing water-level fluctuation data from the recorders placed near the nesting sites to project operations data where spawning fish are documented. Data will include GPS-mapped locations of fish nests (smallmouth bass and fallfish) and the location of the water-level recorders. The walleye and white sucker spawning locations from egg trap data that were located during field surveys will be mapped with GPS along with the water-level recorders set nearby. All egg trapping sites will be mapped, including those where no eggs are collected.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methodologies presented above are consistent with accepted scientific practice and have been used at other hydroelectric projects in the Northeast, including the Brassua Hydroelectric Project (FERC No. 2615).

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. Given the similarity between studies, results for this study will be combined into a single report along with results from the Resident Fish Spawning in Impoundments Study (Study 14) to provide a more complete picture of the potential project effects on resident fish spawning. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This study will be done in the first study year (2014). Field work to locate spawning fish downstream of the dams will depend on water temperature and ice conditions and could begin in late March/early April 2014 when egg traps will be set for walleye and white suckers. Field work will continue into June to capture the fallfish and smallmouth bass spawning periods. The final study report will be prepared after the field season and the laboratory effort to identify fish eggs collected is completed.

LEVEL OF EFFORT AND COST

The estimated cost of this study is $60,000.

REFERENCES

NHFG (New Hampshire Fish and Game Department). 1998. New Hampshire Fish and Game Department Strategic Plan (1998–2010). Concord, NH.

VFWD (Vermont Fish and Wildlife Department). 2006. Vermont Fish and Wildlife Strategic Plan.

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REVISED STUDY 16

SEA LAMPREY SPAWNING ASSESSMENT

RELEVANT STUDY REQUESTS

FWS-12; NHDES-19; NHFG-19; VANR-17; CRWC-29

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHDFG, VANR, and CRWC identified issues related to potential effects of operation of the Wilder, Bellows Falls, and Vernon Projects on sea lamprey spawning habitat and activity in the Connecticut River.

The goal of this study is to assess the level of spawning activity by sea lamprey (*Petromyzon marinus*) in the project-affected areas and to determine whether project operations are affecting the success (i.e., survival to emergence) of lamprey spawning. New Hampshire and Vermont have classified sea lamprey as an SGCN, thus, as stated in Vermont's Wildlife Action Plan (Kart et al., 2005), "research and monitoring needs for SGCN include monitoring and assessing populations and habitats for current conditions and future changes, and identifying and monitoring problems for species and their habitats." New Hampshire has listed the conservation status of sea lamprey as "vulnerable."

The objectives of this study are to:

- identify areas within the Wilder, Bellows Falls, and Vernon Project-affected areas and riverine reaches where suitable spawning habitat exists for sea lamprey;
- conduct a telemetry study of sea lamprey during their upstream migration period in the spring, focusing on areas of suitable spawning habitat and areas of known spawning;
- conduct spawning ground surveys to observe the use of this habitat for spawning purposes and, hence, confirm suitability;
- obtain data on redd characteristics, including location, size, substrate, depth and velocity; and
- assess whether operations at the Wilder, Bellows Falls, or Vernon Projects adversely affect these spawning areas, specifically if flow alterations cause dewatering and/or scouring of sea lamprey redds.

Results of the study will provide information on sea lamprey spawning locations within the three project-affected areas, lamprey redds will be characterized, and spawning success will be assessed. An analysis of the effects of project operations on spawning success, potential habitat degradation and larval viability will be presented.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS

- General goals for relicensing including ensuring that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives and conserving, protecting, and enhancing habitats for fish, wildlife, and plants affected by the projects.
- General goals related to aquatic resources including protection, enhancement, or restoration of aquatic and riparian habitats; providing instream flows to meet the requirements of diadromous and resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.

NHDES

- State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.

NHFG

- Sea Lamprey is a state SGCN.
- General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR

- State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat.
- General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.
- VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species and the ecological processes that support them; and providing fish and wildlife-based activities including viewing, harvesting and utilization of fish, plant and wildlife resources. Goals reference Vermont's Wildlife Action

Plan (Kart et al., 2005).

- VFWD general goals related to resource conservation, fish, and wildlife recreation and use, and human health and safety.
- Goals reference Vermont Fish and Wildlife Strategic Plan (VFWD, 2006), including SGCN.

ASSOCIATION WITH OTHER STUDIES

Analysis of data and conclusions in this study will be informed by data collected in several other studies, including Instream Flow (Study 9), Aquatic Habitat Mapping (Study 7), Tributary and Backwater Fish Access and Habitats (Study 13), Hydraulic Modeling and Operations Modeling (Studies 4 and 5), Upstream Passage of Riverine Fish (Study 17), and Fish Assemblage (Study 10).

Studies 7, 9, and 13 will provide additional information on the availability, or lack of, sea lamprey spawning habitat within the project-affected areas and where suitable habitat is found (i.e., backwater areas and tributaries). The Operations Modeling Study (Study 5), which will help discriminate between the effects associated with project and non-project flows, and Studies 10 and 17 will allow for a closer evaluation of the results of this study. For example, the upstream fish passage study and fish assemblage study will provide relative abundance data on sea lamprey and, therefore, perspective relative to the quantity of spawning sites identified in the project area and their rated success. If some nests are not successful, river flow modeling will help to assess whether project or non-project flows were a factor.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

The sea lamprey is known to spawn in the Connecticut River as far upstream as Wilder dam and in tributaries such as the West, Williams, Black, and White rivers (Kart et al., 2005). Sea lamprey typically spawn in areas of shallow, rapid water conducive to their redds, and near sandy bottom, quiet water being preferred by larvae (Bigelow and Schroeder, 1953). FWS (2012) lists the current upstream extent of sea lamprey range as Bellows Falls dam, noting, however, that reproduction has been documented as far north as the White River, Vermont, in the Wilder Project area. In certain years, hundreds to thousands of sea lamprey have been recorded passing upstream of Bellow Falls dam, and in at least 1 year (2008), sea lamprey were documented passing upstream via the Wilder dam fish ladder. In 2008 surveys, Yoder et al. (2009) documented sea lamprey just downstream of the confluence of the White River.

As reported in the project PADs, 99 lamprey passed Bellows Falls dam in 2012, and 696 passed Vernon dam in that year. The PADs also state that to date no studies are known that address the identification of sea lamprey spawning habitat and activity within the three project areas and no studies are known to address the effects of project operations on those activities.

PROJECT NEXUS

Agencies contend that Wilder, Bellows Falls, and Vernon Project operations have the potential to cause direct effects on spawning habitat and activity downstream of the projects in riverine portions of the river, from water releases during routine operations. If lampreys are actively spawning during operational changes, such as decreased or increased generation, assessing whether these changes adversely affect spawning activity will assist resource agencies in the management of the species. Results of this study should identify whether project operations affect spawning activity of sea lamprey.

STUDY AREA AND STUDY SITES

The study area will encompass the Wilder, Bellows Falls, and Vernon Project-affected areas. Specific sites of interest are likely to be riverine sections of the river downstream of Wilder dam, the stretch of river from Bellows Falls tailrace to about 6 miles downstream, and approximately 1.5 miles downstream of Vernon dam to the downstream end of Stebbins Island.

Sea lamprey typically spawn in areas of shallow, rapid water with cobble/gravel substrate for their redds and sandy/muddy bottom quiet water for their larvae (Bigelow and Schroeder, 1953). Other areas of the projects, i.e., impoundments, will most likely not be suitable for lamprey spawning. Specific lamprey spawning sites within the study area will be identified via radio telemetry of individuals. Lamprey will be trapped at the Vernon fish ladder, radio tagged, and released just upstream of Vernon dam. If suitable numbers of lamprey arrive and pass the Bellows Falls fish ladder, they will be trapped, radio tagged, and released above Bellows Falls dam for migration upstream toward the Wilder Project. No lamprey will be double tagged. Tagged lamprey will be followed throughout the project impoundments and riverine sections and into project-affected tributary areas until they exhibit stationary behavior implying spawning activity.

METHODS

Methods to be used in this study generally follow those requested by stakeholders in their study requests, as described below.

If present, up to 20 sea lamprey will be collected at each of the Vernon and Bellows Falls fish ladders. It is expected that tracking tagged lamprey will reveal spawning locations and that these spawning locations, if suitable, will be inhabited by non-tagged lamprey as well. Lamprey will be collected and tagged as they enter and traverse the ladder, and they will be released just upstream of the dam. Lamprey will be selected and tagged to reflect the breadth of the migration period. At the Vernon Project, six lamprey will be tagged during the early arrivals, seven at the projected mid-point, and seven tagged during the latter portion of the run. The same methods will be used at Bellows Falls Project. Records of lamprey passage at Vernon and Bellows Falls Projects will be analyzed to gage when the migration period may near its peak and when it may end in order to select specimens to radio tag. If, during the migration period, it appears few lamprey are arriving, and fewer than 20 fish are collected at the Bellows Falls fish ladder as the ambient water temperature approaches 15°C (since lamprey spawn between 10 and 20°C), additional fish may be taken from Vernon, tagged, and transported to above Bellows Falls dam for release to expedite arrival at spawning areas.

TransCanada will share radio frequency information with FirstLight and expects FirstLight will share its frequencies as well, so that tagged fish that move from the Turners Falls Project (FERC No. 1889) upstream into the Vernon Project vicinity can be monitored.

Lamprey will be radio tagged using techniques described in Hanson and Mathur (2002). These techniques are very similar to those described in Noyes et al. (2011) and Moser et al. (2002). Briefly, sea lamprey will be anesthetized, weighed, and measured for total length and girth and surgically implanted with a radio transmitter. Tagged lamprey will be allowed to recover in a flow-through water bath for 4 to 5 hours before release. They will be placed in a truck-mounted transport tank or live well on a boat for release mid-channel just upstream of Vernon dam and just upstream of Bellows Falls dam. Releases will be made after sunset in adherence to widely accepted methodology.

Each transmitter will be of suitable size, weight not to exceed 3 percent of lamprey weight, and most likely all transmitters will operate on at least 20 different frequencies. Lamprey will be manually tracked by boat, car, or possibly aircraft if lamprey cannot be located otherwise, and locations will be recorded for each tracking event. Any untagged lamprey observed during tracking will have their locations documented by GPS. Once tagged lamprey have reached suspected spawning grounds within the project-affected areas, the area in the immediate proximity of tagged fish will be visually inspected by scuba, snorkeling, and/or boat-mounted observation gear to discern whether the habitat is suitable for spawning (i.e., shallow, rapid water or sandy/ muddy bottom areas nearby). Fish that move outside of the project-affected areas will be noted as having left, followed until they exhibit stationary behavior indicating potential spawning, and will not be tracked further into non project-affected waters. If all radio-tagged individuals are not located by boat or motor vehicle, efforts will be made to survey project-affected areas of tributaries as feasible via airplane to locate those lamprey. All tagged lamprey found outside the project-affected areas will be reported to the FWS, and state agencies and the frequencies of those lamprey will be provided.

Once an area within project-affected areas is deemed suitable for lamprey spawning activity, it will be characterized for substrate, depth, and GPS location and monitored frequently, approximately once every 2 or 3 days, depending on how many spawning areas are found. Water quality (temperature, DO, turbidity, pH, and conductivity), water velocity, embeddedness, and depth will be measured over the range of normal project operations. Once redds are established within the project-affected areas and spawning activity commences, these redds will be monitored daily and a sub-sample will be randomly capped and emerging larvae enumerated following methods by Fox et al. (2010). All redds found within project-affected areas, whether located via radio telemetry or during Studies 7, 9, and 13 will be enumerated and monitored if feasible. Efforts will be made to accurately monitor, photograph and measure variables near the redds without disturbing spawning and rearing. Methods described by Bonar et al. (2009) will be used to count and monitor redds.

All spawning grounds within project-affected areas will be observed from the time of lamprey arrival to the time of larval lamprey departure, or until the water temperature exceeds 22^{o}C since lamprey spawn between 10 and 20^{o}C (Bigelow and Schroder, 1953). All redds will be enumerated and a sub-sample of redds (to include as much habitat variability as possible) will be chosen to monitor daily. The number of redds monitored will depend on the density (number of redds/acre). As many redds as possible in each project area, up to a maximum of 25, will be monitored extensively. Environmental variables including water velocity, depth, temperature, exposure, and relative condition of redds/area will be measured, and the grounds photographed, if possible, over the range of normal project discharges to characterize operational effects. Preliminary information from the Hydraulic Modeling Study and Operations Modeling Study (Studies 4 and 5) will help to correlate project operations during spawning. Any changes to the habitat and/or redds will be described and recorded. Embeddedness—the ratio of sand and sediment in gravel—will be characterized with the Bresven Index (Gallagher, 2007) and monitored over the life of the active redd for each redd monitored. A selected number of redds that may be in jeopardy of becoming de-watered during project operations will be monitored with depth-calibrated pressure transducers.

It is expected that some radio-tagged sea lamprey will migrate to areas not affected by project operations, such as into the White or West rivers. In that event, individuals will be monitored to a much lesser extent and gross observations (from shoreline or wading) of their activity will be conducted. Tagged lamprey may also move to locations in some tributaries that may be affected by project operations, such as near the confluence or just within the tributary in a location that may be affected by operations (e.g., just within the Saxtons River or the Cold River). In cases such as these, where tributary inflows or other non-project-related variables may be a factor in lamprey behavior, all possible environmental variables will be measured and recorded, e.g., water depth, velocity, and temperature., so that normal project operations and other contributing effects might be isolated.

ANALYSIS

All radio transmitters will have a unique frequency or code, thus allowing discrimination by individual. All radio-telemetry data will be compiled, reduced, and sorted according to individual lamprey. Data from any related FirstLight study will be incorporated into this dataset, if available. Locations of each tagged lamprey will be presented spatial-temporally in tabular and graphic form. Coordinates of spawning locations for all tagged fish that participate in spawning within project-affected areas will be identified graphically on maps. The last known location of each tagged fish that moves out of the project areas will also be identified. Congregation areas of radio-tagged sea lamprey will be compiled and presented graphically on maps and with aerial photography. Additional non-tagged lamprey and their redds, as well as redds identified during Studies 7, 9, and 13, will be enumerated and included within the redd monitoring for project operational effects. Areas within the project-affected areas will be classified as follows:

1. non-suitable spawning habitat,

2. suitable spawning habitat but no observed spawning,

3. active spawning area, and

4. active spawning area with larval sampling.

These classified areas will be described as to substrate composition, and classes 2, 3, and 4, will be described as to range and average depth, range and average temperature, range and average water velocity, and range and relative clarity over the course of spawning and rearing activity. Project operations, turbine discharge, spill discharge, and water elevation will be recorded hourly, and these data will be correlated to changes observed and water-level measurements taken at the lamprey redds.

Success of spawning by sea lamprey within the project-affected areas will be characterized by emergence of larvae from capped redds, if larvae emerge, spawning was successful. If eggs do not hatch and no larvae emerge, spawning was not successful. Emerging larvae will be enumerated, and timing of emergence relative to redd construction will be documented. Redds will be characterized as to location, range and average depth, general surrounding substrate, and range and average water velocity.

In order to gage the effects of project operations on the physical spawning habitat and success of spawning by sea lamprey within project-affected areas, all collected data will be analyzed (by colony/grouping in each habitat area to the extent possible based on identified spawning) and compared to project operations. The date and time of all observed activities, water measurements, and any visual variations of the structural spawning habitat and redd characteristics will be related to the operational data (e.g., total generation, turbine operating, and spill) of the particular project in question. Effects of the projects will be classified per operational regime observed as:

1. no effect — no observable difference to habitat/redd structure or lamprey activity — successful spawning documented;

2. moderate effect — observable difference to habitat/redd structure and/or behavior noticeable but not enough to preclude normal spawning activity — successful spawning documented;

3. large effect — observable structural differences to habitat/redds and observable decreased spawning activity — minimal to no successful spawning documented; or

4. Severe effect—noticeable habitat/redd degradation, i.e., de-watered, scoured out, and conditions, depth, water velocity preclude normal spawning—no successful spawning documented.

If radio-tagged sea lamprey migrate to areas not affected by project operations, gross observations of their activity may reveal whether they spawned in those areas, and the resource agencies will be notified and provided with tag frequency information. These data will be presented as ancillary observations. If tagged lamprey move into locations in tributaries that may be affected by project operations, all data will be analyzed to the extent possible, and non-project effects will be compared to project operational effects to identify the extent of each contributing factor.

Other related studies (4, 5, 7, 9, and 13) should provide additional information on available sea lamprey spawning habitat and flows within the project-affected areas. Results of these studies will supplement and possibly support the analyses of this study when the results of those studies are available.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The study methodology is consistent with generally accepted scientific practice. Radio telemetry of both Pacific and sea lampreys has been conducted and accepted for many years. Habitat descriptions and measurement of environmental variables as described above have also been widely conducted for years.

DELIVERABLES

A final study report will be prepared after the first year field season. This reporting period depends on analyses and reporting of related habitat studies. In addition, if project operations were not reasonably typical during the study year, a second year of study may be warranted. A draft final study report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license applications for the projects. Exhibit E of the final license applications will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license applications.

SCHEDULE

This study will be conducted in the first study year (2014). Lamprey collection and tagging would likely commence at the Vernon fish ladder between mid-April and early May, depending on water temperature. Specimens will be tagged over the extent of the projected run. All specimens should be tagged and released by the end of May or mid-June. Lamprey will be monitored during May and early June, and once all lamprey have arrived at suspected spawning sites in mid- to late-June, field observations will commence. The field observations will most likely end by mid- to late July. Data compilation, reduction, and analysis will be conducted directly after the field season. A final report including relevant data from related studies will be prepared after data from those studies are available, analyzed, and incorporated into this study's dataset.

LEVEL OF EFFORT AND COST

The estimated cost for this study is $150,000 for one field season.

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REVISED STUDY 17

UPSTREAM PASSAGE OF RIVERINE FISH SPECIES ASSESSMENT

RELEVANT STUDY REQUESTS

FWS-16; NHDES-20; NHFG-20; VANR-24; CRWC-20

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHFG, VANR, and CRWC identified issues related to upstream passage of riverine fish species at the Wilder, Bellows Falls, and Vernon Projects. Specifically, requesters indicated that no information exists to assess existing year-round fishway use by resident fish species or to indicate whether existing upstream passage at the projects is adequate for riverine and diadromous fish species. Due to the logistical difficulties of operating project fishways during the winter because of icing and potential damage to the facilities, monitoring at the TransCanada projects will be limited to the open water season (from ice-out until freezing temperatures make it infeasible). The goals of this study are to determine the use and temporal distribution of riverine fish passing upstream in the existing Wilder, Bellows Falls, and Vernon fish ladders during the open-water period and to determine the appropriate operation period for these fishways to pass riverine and diadromous fish.

The objectives of this study are to:

- identify the use and temporal distribution of upstream passage through the Wilder, Bellows Falls, and Vernon fishways by riverine and diadromous fish species;

- operate and monitor the fishways during the open-water period (ice-out until freezing temperatures make it infeasible) to assess fishway use over a longer period than the existing May–July period;

- identify potential appropriate operating windows during the open-water period for the fishways for riverine species; and

- identify potential appropriate operating windows during the open-water period for diadromous species, such as American eel and sea lamprey.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS	• General goals for relicensing including ensuring that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife

objectives and conserving, protecting, and enhancing habitats for fish, wildlife, and plants affected by the projects.

- General goals related to aquatic resources including protection, enhancement, or restoration of aquatic and riparian habitats; providing instream flows to meet the requirements of diadromous and resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.

NHDES

- State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.

NHFG

- General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR

- State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat.
- VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them; and providing fish and wildlife-based activities including viewing, harvesting, and utilization of fish, plant, and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005).
- VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety.
- Goals reference Vermont Fish and Wildlife Strategic Plan (VFWD, 2006).

ASSOCIATION WITH OTHER STUDIES

This study relates to two other requested studies. Data collected from the Sea Lamprey Spawning Assessment (Study 16) and American Shad Telemetry Study – Vernon (Study 21) that will provide additional information on upstream fishway usage by these species. In those studies, adult sea lamprey and adult American shad will be monitored as they approach and potentially attempt to pass the Bellows Falls and Wilder fishways, and American shad will also be monitored at the Vernon fishway.

It is expected that radio-tagged shad and sea lamprey tagged downstream by FirstLight will also be monitored if they attempt upstream passage at any of the three project fishways.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

No information exists that will allow for a comprehensive assessment of existing year-round fishway use by resident fish species. The requesters provided some summary data in their study requests on passage numbers of resident fish at Vernon dam in 2012, but they noted that those analyses were conducted during 1 year and did not include any monitoring outside of the May through July period. In the PADs for the Wilder and Bellows Falls Projects, TransCanada identified resident fish species recorded using the Wilder and Bellows Falls fishways and indicated that the data are available from VFWD. TransCanada also noted that VFWD has several years (2007–2012) of seasonal fish passage data not yet analyzed for the May through July period.

This study will fill the data gaps about potential upstream passage usage of the project fishways by resident and diadromous fish during the other open-water periods of the year.

PROJECT NEXUS

The Wilder, Bellows Falls, and Vernon dams are a physical impediment to upstream fish passage for both resident and diadromous fish. The three dams have a direct effect on fish species attempting to move upstream and may prevent some fish from accessing aquatic habitat upstream of the dams. Operating the fishways beyond the normal May–July period and documenting the usage by resident and diadromous fish species will provide the data needed to determine the level of riverine fish passage through the existing fishways. The data from this study will also provide information on the temporal distribution of riverine and diadromous fish passage.

STUDY AREA AND STUDY SITES

The study sites include the fish ladders at the Wilder, Bellows Falls, and Vernon Projects.

METHODS

Salmonsoft FishTick/FishRev digital video counting systems will be set up and maintained in the fishway windows of each of the three fish ladders. TransCanada intends to make use of three Salmonsoft software licenses offered by VANR to assist with this study. Three laptop computers meeting the minimum requirements for the Salmonsoft software will be purchased by TransCanada and used during this study. Fishways will be monitored using Salmonsoft 24 hours a day during the study period. TransCanada will coordinate with FWS and CRASC to ensure that fishway inspections are conducted in a timely fashion, so installation of cameras and monitoring of passage is not delayed. Equipment will be set up and ladders operated as soon as feasible considering river, ladder, and operational conditions during late winter or early spring 2014.

Salmonsoft counting systems will be checked weekly to ensure proper operation and to retrieve video files for analysis. The Salmonsoft counting systems will be quality control checked during the study to determine the accuracy of the counts. This quality control check will be accomplished by operating a second video camera on randomly selected days that is not using Salmonsoft and comparing the results. Previous use of the Salmonsoft counting systems by VANR and FirstLight have noted that turbidity can limit the effectiveness of the program's ability to detect and record fish. As a result, TransCanada will rely on the operation of a second in-air video camera (non-Salmonsoft) recording in the counting window following rain events and high-flow periods. In addition, TransCanada will consult with both VANR and FirstLight to ensure that Salmonsoft equipment is properly installed to account for the effects of both sunlight (i.e., proper shade screening will be installed) and night time (i.e., directed lights will be installed). Care will also be taken to adapt methods previously used at Connecticut River projects to obtain a net count of fish, accounting for movements upstream and downstream of individuals.

Trained personnel will process and review video files throughout the study. TransCanada intends to make use of 2013 Salmonsoft data collected by VANR for the purposes of training project staff on the correct identification of unique fish species. Monthly tables will be created that detail hourly fish passage results at each fishway. Data will include number of fish, species, water flow through the project (generation, spill, attraction and fishway flows), water temperature, and time of passage.

Fishways will be visited on a weekly basis and video files will be downloaded at that time. TransCanada will internally coordinate with project personnel to conduct an initial inspection after the 2013 passage season to determine the of debris accumulation during an operating season. Fish ladders will be shut down and pressurized water will be used to flush stranded fish down the ladders. Then, visual inspections can take place from overhead rather than from within the ladders since entry is restricted due to the ladders being subject to the Occupational Safety and Health Administration's confined space entry requirements.

Fish ladders will be cleaned prior to the study year, and a protocol for weekly inspections at each fishway will be developed to evaluate potential blockages to passage during the study year. If these weekly checks indicate that a significant blockage or obstacle to upstream passage is present, a post season shut down may be implemented (i.e., following spring passage season and/or following the summer season). TransCanada will consult with the aquatics working group on the need for dewatering and inspection during the study period. In addition to monitoring passage obstacles, temperature monitors will be placed in each fishway, in the forebays at fishway exits, and in the tailraces. Operational parameters for the ladder (e.g., attraction flow, tailrace and headpond elevations) will be recorded for the period of operation.

TransCanada will regularly confer with the aquatics working group regarding equipment operation and monitoring. If for unforeseen reasons, use of the Salmonsoft counting system or 24-hour monitoring become problematic, TransCanada will investigate alternate methods of monitoring.

ANALYSIS

Results of this study will be presented in graphical and tabular format. The usage and temporal distribution of riverine and diadromous fish passage at each of the three fish ladders during the open-water season (from ice-out until freezing temperatures make it infeasible) will be documented after reviewing all the recorded digital files collected during the study.

Radio telemetry data on upstream migrating shad and sea lamprey attempting upstream passage at any of the three fishways gleaned from the related sea lamprey and shad studies (Studies 16 and 21) will also be analyzed and summarized as part of this study.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The use of cameras to record upstream fishway use by resident and diadromous fish has been used at the Merrimack Hydroelectric Project (FERC No. 1893) and at other locations in the Northeast, including the fishway monitoring conducted annually by VFWD since 1985.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This study will be conducted during the first study year (2014). Cameras and recording equipment will be setup in the count windows at each of the three fishways as soon as feasible during late winter or early spring 2014 and will be operated until icing in the fishways makes sampling prohibitive during the winter of 2014/2015. A final report will be prepared after the study field season and data analysis is completed.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this study is approximately $138,000 total.

REFERENCES

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REVISED STUDY 18

AMERICAN EEL UPSTREAM PASSAGE ASSESSMENT

RELEVANT STUDY REQUESTS

FWS-09; NHDES-24; NHFG-24; VANR-22; CRWC-27; TU-08

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHFG, VANR, CRWC, and TU identified potential issues related to upstream American eel passage at the Wilder, Bellows Falls, and Vernon Projects. TU only requested upstream eel studies for the Bellows Falls and Vernon Projects; the other five requestors also included the Wilder Project. Specifically, requesters indicated that the dams may increase residency time of upstream migrating American eels trying to access historical rearing habitat and information is needed on where and at what concentrations American eels are congregating downstream of the projects.

The goal of this study is to provide baseline data on the presence of American eels attempting to move upstream of the projects and the locations where they congregate while attempting upstream passage.

The objectives of this study are to:

- conduct systematic surveys of eel presence/abundance at tailrace and spillway locations at the Wilder, Bellows Falls, and Vernon Projects to identify areas of concentration of eels staging in pools or attempting to ascend wetted structures (study year 1); and

- collect eels with temporary trap/pass devices from areas identified from the surveys at locations of eel concentrations to assess whether eels can be collected and passed in substantial numbers (study year 2).

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS	• Specific goals related to American eel include minimizing project effects that could hinder management goals; and minimizing project effects on upstream passage, injury, and stress to facilitate access to historical rearing habitat. Goals reference ASMFC Interstate Fishery Management Plan for American Eel (ASMFC, 2000); ASMFC Addendum II to the Fishery Management Plan for American Eel (ASMFC, 2008); and CRASC Management Plan for American Eel (*Anguilla rostrata*) in the

	Connecticut River Basin (CRASC, 2005).
	• General goals for relicensing including ensuring that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives; and conserving, protecting, and enhancing habitats for fish, wildlife, and plants affected by the projects.
NHDES	• State water quality standards and designated uses for Class B waters, including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	• American eel is a state SGCN. Specific goals include minimizing project effects on upstream passage, injury, and stress to facilitate access to historical rearing habitat. Goals reference ASMFC (2000), ASMFC (2008), and CRASC (2005).
	• General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference the New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).
VANR	• American eel is a state SGCN. Specific goals include minimizing project effects that could hinder management goals; and minimizing project effects on upstream passage, injury, and stress to facilitate access to historical rearing habitat. Goals reference ASMFC (2000), ASMFC (2008), and CRASC (2005).
	• General goals for relicensing including ensuring that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives; and conserving, protecting, and enhancing habitats for fish, wildlife, and plants affected by the projects.
	• VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them; and providing fish- and wildlife-based activities including viewing, harvesting, and utilization of fish, plant, and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005), including SGCN.
	• VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety.
	• Goals reference Vermont Fish and Wildlife Strategic Plan (VFWD, 2006), including SGCN.

ASSOCIATION WITH OTHER STUDIES

This study is part of a group of studies related to American eel in the project areas. Related studies include the American Eel Survey (Study 11), American Eel Downstream Passage Assessment (Study 19), and American Eel Downstream Migration Timing Assessment (Study 20). Together, these four studies will provide a more complete picture of American eel usage of the mainstem river in project-affected areas and the potential project effects.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

No information currently exists about where upstream migrating American eels might be concentrating below the three dams as they seek upstream passage, or the annual numbers of eels attempting to ascend the dams.

While eels have been documented ascending the Bellows Falls and Vernon fishways, fishway efficiency for passing eels is also unknown. The existing upstream fishways were designed to pass Atlantic salmon and American shad, the primary species of concern when fishery agencies were considering fish passage at the projects. Although some eels ascend the fishways, agencies are concerned that smaller eels may encounter velocity barriers within the fishways that increase their residency time below the dams.

PROJECT NEXUS

The three project dams create impediments to upstream migrating eels. The dams directly affect some of the eels' ability to pass upstream due to dam height; the existing fishways were not designed for eel passage and may present a velocity barrier for some smaller eels. The results from this study will provide information on specific locations where eels attempting to move upstream may concentrate downstream of project facilities.

STUDY AREA AND STUDY SITES

The study area includes the tailrace and spillway locations at the Wilder, Bellows Falls, and Vernon dams and the Bellows Falls bypassed reach. During the first year of study, systematic surveys will be conducted at each site to document the presence and relative abundance of eels. Surveys will be conducted in the spillway areas, especially where there is significant spill or leakage flow where eels may attempt to climb. Visual searches and eel pot trapping will also be conducted around the fish ladders and in the Bellows Falls bypassed reach during the first year of study. If needed during the second year of study, temporary eel trap passes will be installed in areas downstream of project spillways, fish ladders, and/or bypassed reaches where concentrations of eels were identified during systematic surveys.

METHODS

Systematic Surveys (Year 1)

During the first year of study, visual surveys will be conducted at night, once per week, downstream of each dam on foot (wading) or from a boat from May 1 through October 15 (or when water temperature exceeds 50^{o}F). Visual surveys will be done in areas where eels are likely to congregate below each dam, such as spillways, places where there is significant leakage or overflow points along the dams, the Bellow Falls bypassed reach, and in areas near the upstream fish ladders. Data collected will include location (GPS coordinates), observation of eels (presence, absence, numbers, estimated sizes), time and date of observation, field notes on weather conditions, and moon phase. Other data that will be recorded include notes on project operations during sampling such as spill gates that may be open and/or spill conditions during high flows.

A minimum of 10 baited eel pots per project will be fished once per week (overnight sets) from May 1 through October 15 downstream of the Wilder, Bellows Falls and Vernon projects. Areas to be sampled include below the spillways, Bellows Falls bypassed reach, near fish ladders, and in locations that upstream migrating eels may congregate. Eel pots will consist of standard double-entry, 1/8" galvanized wire mesh cylinders approximately 1.5-feet long. Eel traps will be weighted to remain on station for the duration of their soak time and will be retrievable via a float line. Traps will be baited using dead herring or other appropriate bait (e.g., chicken liver, cat food, and canned fish). Data collected will include location, number captured (or recorded as none captured), relative sizes, and time and date of observation. Each eel will be assigned a length class (0 to 6 inches, 6 to 12 inches, 12 to 18 inches, and >18 inches). The first 10 individuals within each length class will be individually measured for total length (nearest mm) and wet weight (nearest gram). The first 10 individual eels in the >18-inch length class will also have eye diameter measurements recorded. To facilitate collection of length and weight data as well as prevent unnecessary injuries to the eels, it may be necessary to anesthetize individuals using an appropriate anesthetic for the species (i.e., ice, clove oil, or MS-222).

All eels collected from baited eel pots (and greater than 1 gram, wet weight) will be marked in an effort to identify individuals who may have already been captured to avoid overestimating eel abundance. Any recaptures will be recorded. Eels will be marked using visual implant elastomer tags (VIE), which have been shown to have no significant impacts to growth or mortality in the closely related European eel (Simon and Dorner, 2011). The VIE tag will be injected along the base of the ventral tail fin margin, approximately 1 centimeter (cm) posterior to its origin. Eel pots will be moved to different locations below the dams if no eels are captured in a particular location after 3 weeks of fishing. GPS coordinates will be taken for all eel pot locations.

Temporary/Portable Eel Trap Passes (Year 2)

Should adequate concentrations of eels be identified during the systematic surveys conducted during the first year of study, temporary eel trap passes will be installed and operated at each of the three projects during the second year of study. If concentrations of eels are not located due to low abundance below a project, then eel trap passes will not be fished at that site. Prior to the installation of any temporary eel trap passes, TransCanada will consult with the aquatics working group to review results from the year 1 systematic surveys. During that consultation, TransCanada will seek to reach agreement on appropriate locations for installation of eel trap passes during year 2.

If eel concentrations are located below a project during the systematic surveys, then up to two portable, temporary eel trap passes will be set below each of those dams in the locations where the eels congregated. These eel trap passes will be operated throughout the upstream migration season for eels (May 1 to October 15, or when river temperature exceeds 50^{o}F). The eel trap passes will be operated daily, with catches quantified every 2 to 3 days. Similar to individuals captured by eel pot, all eels collected from the temporary eel trap passes (and greater than 1 gram, wet weight) will be marked in an effort to identify individuals who may have already been captured to avoid overestimating eel abundance. Any recaptures will be recorded. As described above, eels will be marked using VIE tags injected along the base of the ventral tail fin margin, approximately 1 cm posterior to its origin. GPS coordinates will be taken at all the locations the eel trap passes are fished.

One of the temporary eel trap passes may be installed in the lower sections of fishways supplied with minimal attraction flow (0.5 to 1.0 cfs); however, this will only occur if the fishway is dewatered. In another study, Upstream Passage of Riverine Fish Species Assessment (Study 17), the three fish ladders will be operated during the open water period. Study 17 is planned for year 1, which would not conflict with eel trap pass placement in the fish ladders during year 2.

Data recorded from the temporary eel trap passes will include location, trapping interval, number of eels trapped, length, weight, and hydrologic and environmental conditions (water temperature, DO, pH and conductivity, weather conditions, and moon phase) encountered during trapping. Project operations data for any spill events during the study period, including gates that may be open, will also be recorded. Each eel will be assigned a length class (0 to 6 inches, 6 to 12 inches, 12 to 18 inches, >18 inches). The first 10 individuals within each length class will be individually measured for total length (nearest mm) and wet weight (nearest grams). The first 10 individual eels in the >18-inch length class will also have eye diameter measurements recorded. All eels collected from the eel trap passes will be transported and released into the impoundment upstream of where they were collected.

ANALYSIS

Study results will include an analysis of where eels congregate during the visual night surveys and eel pot survey, including GPS coordinates of places where eels were captured or visually seen during night surveys and photos of the locations and eels found during the surveys, if possible. Additional data will include the number of eels captured (in traps); number (or relative number) of eels observed during night surveys; relative sizes, weight, behaviors noted during the survey (visual surveys); and the time, date, and environmental and hydrologic conditions (as described above) encountered during the surveys.

For the eel trap/pass collections, recorded data will include location, trapping interval, number of eels trapped, relative sizes, weights, and hydrologic and environmental conditions (as described above) encountered during the trapping period.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methodologies presented above are consistent with accepted scientific practice and have been used at other hydroelectric projects in the Northeast, including the Merrimack River Hydroelectric Project (FERC No. 1893).

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

Systematic surveys will begin at all three dams during the first study year (2014) on May 1 and continue through October 15, including weekly eel pot trapping and visual night surveys. Following consultation with the aquatics working group regarding results of the systematic surveys, temporary eel trap passes will be installed during the second study year (2015) below the dams if concentrations of eels are found during the first study year. Two eel trap passes will be set in locations where eels were found congregating by May 1, and traps will be fished through October 15. The field effort will cover 22 weeks of sampling during both years 1 and 2, with the traps being fished every 2 to 3 days during that time period. The study report will be prepared after all field work and data analysis is completed.

LEVEL OF EFFORT AND COST

The estimated cost of this study is approximately $240,000, but it is highly dependent upon the number of eels that arrive and need to be captured and marked with elastomer tags.

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REVISED STUDY 19

AMERICAN EEL DOWNSTREAM PASSAGE ASSESSMENT

RELEVANT STUDY REQUESTS

FWS-11; NHDES-09; NHFG-09; VANR-21; CRWC-28; TU-06

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHFG, VANR, CRWC, and TU identified a potential issue related to potential effects of operations of the Wilder, Bellows, and Vernon projects on American eel during the silver phase. Specifically, the issue is whether project operations negatively affect emigration of American eels.

The study goals are to identify project-related effects on downstream passage timing, injury, stress, and survival in order to maximize the number of American eels migrating to their spawning grounds.

The specific objectives of this study are to:

- quantify the movement rates, timing, and relative proportion of silver eels passing via various routes at the projects including through the turbines, the Bellows Falls bypassed reach, downstream passage facilities, and spillways; and
- assess instantaneous and latent mortality and injury of silver eels passed through each turbine type.

This study will assess whether project operations are adversely affecting American eel migration timing and survival.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS	• Specific goals related to American eel include minimizing project effects that could hinder management goals; and minimizing project effects on passage timing, injury, stress, and mortality to maximize the number of silver eels migrating to spawning grounds. Goals reference ASMFC Interstate Fishery Management Plan for American Eel (ASMFC, 2000); ASMFC Addendum II to the Fishery Management Plan for American Eel (ASMFC, 2008); and CRASC Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin (CRASC, 2005).

- General goals for relicensing including ensuring that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives; and to conserving, protecting, and enhancing habitats for fish, wildlife, and plants affected by the projects.

NHDES

- State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.

NHFG

- American eel is a state SGCN. Specific goals include minimizing project effects on eel passage, injury, stress, and mortality to maximize the number of silver eels migrating. Goals reference ASMFC (2000), ASMFC (2008), and CRASC (2005).
- General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference the New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR

- American eel is a state SGCN. Specific goals include minimizing project effects that could hinder management goals; and minimizing project effects on passage timing, injury, stress, and mortality to maximize the number of silver eels migrating to spawning grounds. Goals reference ASMFC (2000), ASMFC (2008), and CRASC (2005).
- State water quality standards for designated uses of Class B waters relative to levels of water quality that fully support aquatic biota and habitat.
- General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.
- VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them; and providing fish and wildlife-based activities including viewing, harvesting, and utilization of fish, plant, and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005), including SGCN.
- VFWD general goals related to resource conservation, fish and

wildlife recreation and use, and human health and safety.

- Goals reference the Vermont Fish and Wildlife Strategic Plan (VFWD, 2006), including SGCN.

ASSOCIATION WITH OTHER STUDIES

This study is part of a group of studies related to American eel in the project areas. Related studies include the American Eel Survey (Study 11), American Eel Upstream Passage Assessment (Study 18), and American Eel Downstream Migration Timing Assessment (Study 20). Together, these four studies will provide a more complete picture of American eel usage of the mainstem river and project areas and potential project effects.

EXISTING INFORMATION

American eels have been collected both upstream and downstream of the Vernon Project and also have been counted passing the upstream fish ladder. Eels have been documented upstream of the Bellows Falls Project by NHFG (unpublished data) and Yoder et al. (2009), and although passage into the Wilder Project area is conceivable (based on their presence upstream of Bellows Falls), American eels were not documented in the Wilder Project area during the most recent survey (Yoder et al., 2009). To date, no directed studies of eel entrainment or mortality have been conducted at any of the projects.

Within the past 7 years, FWS has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005, FWS issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007, with a finding that listing was not warranted. The second petition was filed on April 30, 2010, by the Council for Endangered Species Act Reliability. On September 29, 2011, FWS issued a substantial 90-day finding and initiated a 12-month status review. FWS is still accepting new American eel information for the ongoing status review. The date for completion of the 12-month finding on the latest petition is uncertain.

PROJECT NEXUS

The Wilder, Bellows Falls, and Vernon Projects operate as daily peaking facilities, except during periods when inflow exceeds the hydraulic capacities of generation. Silver phase American eels emigrate during the mid-summer through late fall, a time of year when flows are generally within the operating capacities of the projects except during high water events. Therefore, eels would likely pass the projects through the turbines, open fish passage facilities or spill gates if open. Because little information exists and silver eels are known to be present upstream of Vernon and Bellows Falls projects, and potentially in the Wilder Project, it is necessary to understand how they move downstream through the projects and to assess what level of injury or mortality caused by passage during emigration may occur.

STUDY AREA AND STUDY SITES

The study areas associated with assessing movement rates and passage through the dams encompass the Wilder, Bellows Falls, and Vernon Project forebays, tailraces, turbines, downstream fish bypass routes, and spillways.

METHODS

American silver eel downstream passage will be assessed by radio tagging and systematically monitoring fish movements and passage through each of the routes through the projects. The methods in this study incorporate the use of radio telemetry and balloon tag methodology as requested by the agencies, but do not include the use of passive-integrated transponder (PIT) tags because PIT tags would provide little additional information for determining passage route selection or passage survival, and only the open fish passage facilities would be conducive to installing PIT tag readers so the remaining potential passage routes would not be monitored by that method. PIT tag monitoring would require a confined limited range antenna for each potential passage route (e.g., individual turbine intakes, bypasses). Although it is theoretically possible to monitor the turbine intakes for PIT tagged fish, the spillways and Bellows Falls bypassed reach could not be monitored at all with this methodology.

Downstream passage survival will be assessed by using HI-Z Turb'N Tag mark/recapture methodology. In their study requests, resource agencies proposed evaluating survival at all potential passage routes at each project; however, TransCanada believes that passage survival through the fish passage facilities and through spill gates and structures is likely to be high since most primary spill gates open from the bottom of the gate rather than at the top (tainter gates at Wilder and Vernon, and roller gates at Bellows Falls) and these gates pass a large volume of water due to their large sizes. Therefore, the focus of the survival study is on turbine passage alone. This portion of the study will use 300 eels, proportionally allocated by the number of different turbine types at each project (two at Wilder, one at Bellows Falls, and three at Vernon). This approach will provide more reliable survival estimates because the sample size for each test will be increased.

If the route selection portion of the study indicates that a significant proportion of fish use the spillways and/or passage facilities survival is low through those routes, TransCanada will consult with the aquatics working group on any potential changes to the scope of the survival portion of the study and consider options to assess the specific routes that appear to be preferred.

Route Selection

American eel downstream passage will be assessed by radio tagging and systematically monitoring fish movements and passage through each of the projects from late August through mid-October.

Silver phase American eels for the study will be collected at either the Turners Falls or Holyoke bypass samplers, or as suggested by the resource agencies, from out-of–basin if needed to meet the sample size requirements. All collections will occur from late August to mid-October to coincide with the expected natural emigration period. Following collections or acquisition, eels will be transported and retained in appropriate holding facilities in a secure location at the Vernon Project.

Only eels that meet the morphometric criteria (eye diameter relative to body size as described in Pankhurst, 1982) will be used to ensure they are silver phased migrants. It is expected that any eels obtained from an out-of-basin source will be of similar size to those collected at the Turners Falls or Holyoke bypass samplers.

Remote telemetry monitoring will occur at the project forebays, log booms, fish passage routes, turbines, tailraces, and spillways. Additionally, monitoring will occur in the power canal at Bellows Falls, the Bellows Falls bypassed reach, and the fishway attraction water intake at Vernon if it is operational during the course of this study.

Radio receivers and/or Digital Spectrum Processors capable of monitoring multiple radio channels simultaneously at each location will be coupled with appropriate antennas and calibrated to ensure adequate coverage of the individual sites to be monitored while minimizing overlap between the sites. It is expected that 18 monitoring sites will be installed. Data collection from the remote telemetry monitoring stations will occur at least three times per week. Periodic manual monitoring by vehicle or boat will also occur at least two times per week to assist in data collection and analysis. Eels will be monitored until all have either left the study area or tag life has expired, whichever occurs first.

Radio transmitters of a suitable size and weight and having a minimum calculated life of 90 days will be used. Each transmitter will contain a unique pulse code to allow for individual fish identification and be compatible with Digital Spectrum Processors. The radio tag channel/code set will be designed to ensure tagged eels released upstream of Wilder and Bellows Falls will subsequently be able to be monitored at the TransCanada facilities downstream, thus increasing the sample size at those facilities.

In the event that FirstLight conducts a similar study within the Turners Falls Project area, TransCanada will share radio frequency information, and expects that FirstLight will share its frequencies as well, to ensure that tagged fish that may move from the Turners Falls Project upstream into the Vernon Project or vice versa, will be monitored. TransCanada will also share tag information with agencies for agency tracking of eels outside of the project-affected areas.

For testing, 50 silver phase eels will be radio tagged following procedures established in Welsh et al. (2009) and released approximately 3 miles upstream of each project in five separate groups of 10 fish each, for a total of 150 eels. If possible, releases will occur during spill and non-spill conditions and under low, moderate, and high generation conditions. If spillage from Bellows Falls dam occurs, an additional 50 eels will be released directly into the power canal so an adequate number of eels are exposed to the turbines and fish passage facilities.

During the course of the study, air temperature, water temperature, turbidity, rainfall, river flow, and project operations will be continually collected and retained. Lunar phase will also be noted.

Survival / Injury Studies

American eel passage survival will be assessed by using HI-Z Turb'N Tag mark/recapture methodology at the powerhouse turbines at each of the three projects.

Silver phase eels for this portion of the study will be collected at either the Turners Falls or Holyoke bypass samplers or (as suggested by the resource agencies) out-of–basin if needed to meet the sample size requirements. Collections will occur from late August to mid-October as needed to achieve required numbers of fish and to coincide with the expected natural outmigration period. Following collections, eels will be transported and retained in appropriate holding facilities in a secure location at the Vernon Project.

Only eels that meet the morphometric criteria (eye diameter relative to body size as described in Pankhurst, 1982) will be utilized to ensure they are silver phased migrants. It is expected that eels that may come from an out-of-basin source will be of similar size to those collected at the Turners Falls or Holyoke bypasses.

A minimum 50 HI-Z Turb'N Tagged eels will be released for testing at each turbine type (100 eels at Wilder, 50 eels at Bellows Falls, and 150 eels at Vernon) using methodologies outlined in Normandeau (2010). Turbine survival tests will be conducted at each project as each group of fish has been collected and tagged by injecting tagged eels into turbines at an acceptable unit loading condition agreed upon by the working group following review of previous operational data at each facility. Following release through each turbine tested, the eels recovered alive downstream will be held for 48 hours for observation of injury and latent mortality. Unrecovered balloon tagged eels will be censored from the sample for survival analysis.

During the course of the study, air temperature, water temperature, turbidity, rainfall, river flow, and project operations will be continually collected.

ANALYSIS

Route Selection

The radio telemetry data will be analyzed to determine the number and timing of eels using each downstream passage route at each of the three projects. A comparative analysis of passage routes with environmental and physical variables that occur during the study period will be conducted. The analysis will include 2-D maps of movement and passage for each individual eel. If during spill events, the passage route analysis indicates significant preference for spill routes and downstream radio tag detection suggests poor survival through those routes, additional consultation with the working group will be undertaken to discuss the merits of additional survival estimates and further study of specific spill passage routes.

Survival / Injury Studies

Immediate and latent survival and classification of injuries will be estimated for the turbines at each project using generally accepted practices (Normandeau, 2010). The results will be assessed in conjunction with the physical and environmental conditions that occur during the study. At Wilder and Vernon where multiple turbine types are tested, a survival estimate will be derived individually for each turbine type as well as a composite survival estimate for the project. As noted above, if it is deemed necessary to conduct survival tests or to evaluate survival through desktop analysis for non-turbine routes, details related to methodology and analysis will be developed in consultation with the working group.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The study methodology, data collection, and analysis techniques to complete this study are consistent with generally accepted practices (Normandeau and FPLE, 2007a, b; Normandeau, 2010, 2011a, b; Normandeau and Gomez and Sullivan, 2012).

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. A draft final study report will be provided after the study analysis is complete and the results are available. All study-related data used to develop the report will be made available to stakeholders in digital format upon written request. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license applications for the projects. Exhibit E of the final license applications will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license applications.

SCHEDULE

This study will occur in the first study year (2014). The exact timing of both the route selection and turbine testing portions of the study will depend upon the ease of fish collections earlier in the season (e.g., August/September timeframe). If environmental conditions such as continual high flows and/or spill events during the emigration season compromise the route selection study findings, a second year of the route selection portion of the study may be warranted; however, the timing of a second year study in the fall of 2015 may preclude filing of a final study report by the current ILP study report deadline.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this 1-year study is $400,000 to $450,000, but it is dependent on the effort required to obtain test specimens through field collections.

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REVISED STUDY 20

AMERICAN EEL DOWNSTREAM MIGRATION TIMING ASSESSMENT

RELEVANT STUDY REQUESTS

FWS-10; NHDES-03; NHFG-03; VANR-20; CRWC-26; TU-04

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHFG, VANR, CRWC, and TU identified a potential issue related to the lack of understanding about the outmigration timing of silver phase American eels in relation to environmental factors and operations of mainstem hydropower projects on the Connecticut River, including the Wilder, Bellows Falls, and Vernon Projects, although the TU study request only included the Bellows Falls and Vernon Projects.

The goal of the requested studies was to assess the timing of American eels migrating from the Connecticut River to their spawning grounds. The specific objective is to characterize the general migratory timing and presence of silver phase American eels in the Connecticut River compared to environmental factors including air and water temperature, turbidity, rainfall, river flow, lunar phase, and flow-related operations of mainstem river hydroelectric projects.

TransCanada is interested and willing to contribute to a more in-depth understanding of the timing and cues that initiate the downstream migration of American eel in the Connecticut River. However, it finds that a field study is premature at this time. There have been few documented American eel upstream of the TransCanada projects in the mainstem Connecticut River, as indicated by annual electrofishing conducted in the lower portion of Vernon impoundment by Vermont Yankee and as summarized in the Vernon PAD, and collections made by Yoder et al. (2009) above Bellows Falls and Wilder dams. A robust evaluation of the timing of downstream migration necessarily requires collecting fish through the migration period, as they emigrate. The effort required to catch a reasonable proportion of the few eels that currently emigrate through the projects would be cost prohibitive. Even then, the number of eels collected would likely be too small to draw reasonable conclusions. Therefore, TransCanada proposes to conduct a thorough review of existing eel downstream migration literature. It appears that such a review has not been completed, particularly with an emphasis on the Connecticut River watershed. The review would augment any field data collected at Cabot Station by FirstLight if such a study is conducted.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS	•	Specific goals related to American eel include minimizing project effects that could hinder management goals and minimizing project effects on passage timing, injury, stress, and mortality to maximize the number of silver eels migrating to spawning grounds. Goals reference the ASMFC Interstate Fishery Management Plan for American Eel (ASMFC, 2000); ASMFC Addendum II to the Fishery Management Plan for American Eel (ASMFC, 2008), and CRASC Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin (CRASC, 2005).
	•	General goals for relicensing including ensuring that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives and to conserving, protecting, and enhancing habitats for fish, wildlife, and plants affected by the projects.
NHDES	•	State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	•	American eel is a state SGCN. Specific goals include minimizing project effects on eel passage, injury, stress, and mortality to maximize the number of silver eels migrating. Goals reference ASMFC (2000), ASMFC (2008), and CRASC (2005).
	•	General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference the New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).
VANR	•	American eel is a state SGCN. Specific goals include minimizing project effects that could hinder management goals and minimizing project effects on passage timing, injury, stress, and mortality to maximize the number of silver eels migrating to spawning grounds. Goals reference ASMFC (2000), ASMFC (2008), and CRASC (2005).
	•	State water quality standards for designated uses of Class B waters relative to levels of water quality that fully support aquatic biota and habitat.
	•	General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality

and aquatic habitat.

- VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them and providing fish and wildlife-based activities including viewing, harvesting, and use of fish, plant, and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005), including SGCN.

- VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety.

- Goals reference the Vermont Fish and Wildlife Strategic Plan (VFWD, 2006), including SGCN.

ASSOCIATION WITH OTHER STUDIES

This study (Study 20) is part of a group of studies related to American eel in the project areas. Studies related to this study include American Eel Upstream Passage Assessment (Study 18), American Eel Survey (Study 11), and American Eel Downstream Passage Assessment (Study 19). Together, these four studies will provide a more complete picture of American eel usage of the mainstem river and project areas and potential project effects. In addition, other concurrent studies may provide supplemental information for this study, including the Fish Assemblage Study (Study 10), Upstream Passage of Riverine Fish Species Assessment (Study 17), and Aquatic Habitat Mapping (Study 7).

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Some information is available about the timing of downstream migration of American eel in the Connecticut River watershed and in other basins. Monitoring of the downstream bypass at the Holyoke dam (canal louver array) was performed in 2004 and 2005 (Kleinschmidt, Inc., 2005, 2006; Normandeau, 2007).

Results of the 2004 study indicated outmigration occurred at night, between the hours of 1700 to 0400 with peak activity (70 percent) between the hours of 1900 to 2100. Most eels were collected between October 13 and November 7. In 2005, sampling occurred almost every night from October 5 through November 9. The nightly emigration activity occurred between the hours of 1900 and 2400.

PROJECT NEXUS

Currently the TransCanada projects have little, if any, direct effect on the overall outmigration of Connecticut River American eel because so few eels exist upstream of the TransCanada projects in the mainstem Connecticut River. With increased passage at the Turners Falls Project (FERC No. 1889), a greater number of American eels may penetrate farther up the basin, and ultimately, there may be a need to consider specific downstream passage effects at one or more of the TransCanada projects. Because of the potential for a significant number of eels at some time in the future, TransCanada recognizes that there is a nexus between the projects and the American eel resource.

As stated above, an understanding of the dynamics and triggers for downstream migration would be helpful in developing reasonable plans to address safe downstream passage. Results of this study will be used to contribute to the overall knowledge about the American eel downstream migration in the basin. This approach differs from those requested by resource agencies. The agencies requested continual systematic monitoring of the Holyoke or the Turners Falls bypass facilities via video or DIDSON surveys and a hydroacoustics survey in the Turners Falls intake canal. Because the same request for study has been made to FirstLight, it is not plausible for TransCanada to conduct a field study at the FirstLight Project. If FirstLight conducts a field study at Cabot Station, the field data request to characterize run timing will be fulfilled, obviating the need for TransCanada to request permission of Holyoke Gas & Electric to conduct a study related to TransCanada's projects at the Holyoke Project.

STUDY AREA AND STUDY SITES

The literature review will focus on existing Connecticut River Basin primary publications, reports, and data (as made available). In addition, existing information from basins in the Northeast will be included to compare and contrast with specific information for the Connecticut River Basin. A broader search for information specific to cues that instigate migration will be included. Regardless of basin or even region, such information on migratory cues may be helpful for developing downstream passage plans in the Connecticut River Basin.

METHODS

The method to be used for this study is to conduct a thorough review of currently available literature for the Connecticut River Basin and other rivers in the Northeast to characterize the general timing of the Connecticut River American eel downstream migration.

Both peer-reviewed and grey literature related to American eel downstream migration on the Connecticut River and other river systems in the Northeast and general eel migration biology will be reviewed to quantify and characterize the expected outmigration of silver phase American eels. The review will focus particularly on environmental cues that stimulate migration.

ANALYSIS

Results of the literature review along with results of related TransCanada studies and any field surveys that may be conducted at Turners Falls and shared by FirstLight within this study's report timeline will be compiled, summarized, and presented to the agencies and FERC for review and comment.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The study methodology is consistent with generally accepted practices.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study.

If FirstLight conducts field studies at Turners Falls in study year 1, it is assumed those results will be available to be incorporated into the review (or a report supplement for study year 2 if field study results are not available prior to the due date of TransCanada's report). Additionally, observations of eels from the American Eel Survey (Study 11), Upstream Passage of Riverine Species Assessment (Study 17), and American Eel Upstream Passage Assessment (Study 18) will be included in this analysis.

A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This study will occur in early 2014 through 2015. An interim report will be filed at the end of 2014, and a final report will be completed in 2015 incorporating analysis and data from other studies.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this study is $30,000.

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REVISED STUDY 21

AMERICAN SHAD TELEMETRY STUDY – VERNON

RELEVANT STUDY REQUESTS

FERC-09; FWS-04, -05; NHDES-02, -04; NHFG-02, -04; VANR-11, -12; CRWC-22, -23; TU-02, -03

STUDY GOALS AND OBJECTIVES

In their study requests, FERC, FWS, NHDES, NHFG, VANR, CRWC, and TU identified two issues related to potential project effects relative to adult American shad (*Alosa sapidissima*). One issue concerned upstream and downstream adult American shad passage success on the Connecticut River, leading agencies and nongovernmental organizations (NGOs) to request a study of shad migration from FirstLight's Cabot Station to upstream of Vernon dam. The second issue pertains to American shad spawning behavior, spawning habitat use, areal extent and quality of those spawning areas, and spawning activity in terms of egg deposition in those areas.

Additionally, agencies and NGOs included a request for TransCanada and FirstLight to complete analyses of data collected by USGS on the migration of radio-tagged shad from Turners Falls Project (FERC No. 1889) to Vernon dam and passage efficiency of the Vernon fish ladder. They have requested the analyses be completed as soon as possible so that these analyses can be used as a basis to design subsequent field studies.[1]

This study will include analyses of the USGS 2012 data and an assessment of migration and spawning of shad between Bellows Falls dam and the tailwaters below Vernon dam.

The goals of this study are to:

- characterize effects, if any, of project operations on behavior, approach routes, passage success, survival, and residency time by adult American shad as they move through the Vernon Project during both upstream and downstream migrations; and
- characterize whether project operations affect American shad spawning site use and availability, spawning habitat quantity and quality, and spawning activity in the river reaches from downstream of Vernon dam to the Bellows Falls Project.

[1] While TransCanada has agreed to pay for the completion of FWS/USGS study, the timely completion will depend on timely receipt of all data files.

The objectives of the study are to:

- assess near-field attraction to, and entrance efficiency of the Vernon fish ladder;
- assess internal efficiency of the Vernon fish ladder;
- assess upstream passage past Vermont Yankee's discharge located on the west bank of the river 0.45 mile upstream of the Vernon fish ladder exit;
- assess upstream migration beyond Vernon dam up to the Bellows Falls Project;
- characterize project operational effects on post-spawn downstream migration route selection, passage efficiency, downstream passage timing/residence, and survival related to the Vernon Project;
- identify areas that American shad use for spawning;
- assess effects (e.g., water velocity, depths, inundation, and exposure of habitats) of project operations on identified spawning areas; and
- quantify spawning activity.

This study will provide information about American shad route selection, efficiency, and survival during upstream and downstream passage at the Vernon Project. In addition, American shad spawning areas between Bellows Falls dam and downstream of Vernon dam approximately 1.5 miles will be identified, and spawning activity will be determined. The effects of project operations on upstream passage, spawning, and downstream passage of American shad will be assessed.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS	• Specific goals related to American shad include minimizing project effects on shad spawning and recruitment, and shad passage effectiveness and survival. Goals reference ASMFC Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (ASMFC, 2010) and CRASC Management Plan for American Shad in the Connecticut River (CRASC, 1992). • General goals for relicensing including ensuring that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife

objectives and conserving, protecting, and enhancing habitats for fish, wildlife, and plants affected by the projects.

NHDES

- State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.

NHFG

- Specific goals related to American shad include minimizing project effects on shad spawning and recruitment; and shad migration, false attraction, entrainment, impingement, and survival. Goals reference ASMFC (2010) and CRASC (1992).
- General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference the New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR

- VFWD specific goals related to American shad include minimizing project effects on shad spawning and recruitment, and shad passage effectiveness and survival. Goals reference ASMFC (2010) and CRASC (1992).
- State water quality standards for designated uses of Class B waters relative to levels of water quality that fully support aquatic biota and habitat.
- General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.
- General goals for relicensing including ensuring that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives and conserving, protecting, and enhancing habitats for fish, wildlife, and plants affected by the projects.
- VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them and providing fish and wildlife-based activities including viewing, harvesting, and use

of fish, plant and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005).

- VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety. Goals reference the Vermont Fish and Wildlife Strategic Plan (VFWD, 2006).

ASSOCIATION WITH OTHER STUDIES

The Aquatic Habitat Mapping Study (Study 7) may assist in identifying suitable spawning areas. The Hydraulic Model and Operations Model (Studies 4 and 5) will provide information for this study in terms of water levels, velocities, and flows in relation to shad movement and spawning sites. The Water Quality Monitoring Study (Study 6) will supplement water temperature data recorded by the radio tags used in this study to monitor American shad.

In addition, this study may relate directly to similar shad studies requested of FirstLight. The resource agencies requested shad migration studies related to the Turners Falls Project and Northfield Project (FERC No. 2485). Part of those studies, specifically, migration of radio-tagged shad past the Northfield Project to Vernon dam, may directly add to the sample size of this study, and this study may inform any FirstLight study conducted.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

American shad are known to migrate upstream in the Connecticut River as far as the Bellows Falls Project (Langdon et al., 2006). In 2011, FWS and USGS began a whole-river study of radio-tagged shad migration. This study continued through 2012 but the plethora of data has precluded analyses of overall performance of the Vernon fish ladder to pass shad. The 2011 study identified structural problems with the Vernon fish ladder that limited upstream passage (Castro-Santos, 2011). Subsequently TransCanada repaired the fish ladder, and passage in 2012 was vastly improved in terms of numbers passed and efficiency of the ladder (personal communication, Melissa Belcher, Vermont Fish and Wildlife Department, and Ted Castro-Santos, USGS).

The study conducted in 2012 was a broad-scale monitoring of tagged shad in the tailwaters of the Vernon Project with near-field monitoring of the fish ladder entrance. Via PIT tags, the efficiency of the ladder to pass shad upstream was observed. Detection of post-spawned tagged shad (both PIT and radio) and perhaps downstream passage at Vernon may have been recorded. Although there is valuable information from the 2012 study, it has yet to be analyzed. Therefore, as a component of this study, a review of the 2012 data will be performed in 2013, pending timely receipt of the data. Those data will be used to fine tune the design of this study, including potential changes in sample size, in consultation with the aquatics working group as described in the methods section below.

Resource agencies and NGOs state in their requests that they know of no studies or data available to identify or describe shad spawning areas downstream of Bellows Falls dam or in the vicinity of the Vernon Project. Results of this study combined with the 2012 study results should provide a good representation of American shad migration to and past Vernon and of emigration downstream past Vernon into the Turners Falls impoundment after spawning.

PROJECT NEXUS

Vernon Project operations have the potential to affect water velocity and depth in the shad migration corridors of the Connecticut River. Project flow releases at Vernon dam could affect passage route selection and entry into fishways, increasing tailrace residence time. Project operations could increase forebay residence times and possibly result in higher turbine passage. If normal project operational changes, such as decreased or increased generation, occur during active shad spawning, it is important to assess whether these changes adversely affect spawning activity. Results of this study should help to identify effects of project operations on upstream and downstream passage of shad at Vernon and spawning activity in the project-affected areas.

STUDY AREA AND STUDY SITES

The upstream passage efficiency portion of the study area will encompass the immediate near-field area of Vernon dam for passage evaluations, specifically the immediate Vernon tailrace, fish ladder entrance, and fish ladder proper. The Connecticut River from Vernon dam to the Bellows Falls tailrace will be monitored to assess upstream passage timing through the Vernon impoundment and the riverine section downstream of Bellows Falls.

During the downstream passage of post-spawned shad phase, the immediate Vernon forebay area, turbine intakes, bypass fishpipe entrance and exit, and spillway areas will be monitored. An area of the Connecticut River to approximately 10 miles downstream of Vernon dam near Northfield, MA, will be monitored for survival of downstream passage. This site was used during the USGS shad study and is a relatively secure site for the monitoring equipment.

Specific sites of interest for the spawning phase of the study will be areas identified as potential spawning sites between Bellows Falls dam and approximately 1.5 miles downstream of Vernon dam. Specific shad spawning sites will be determined via radiotelemetry of individuals; because this determination will be a result of the study, it is not specifically known yet. Some shad will also be trapped at the Vernon fish ladder, radio-tagged, and released just upstream of Vernon dam for the spawning phase of the study.

METHODS

It is expected that once the 2012 data have been analyzed in 2013, those data may contribute to existing information to indicate timing of the shad run from Turners Falls to the Vernon Project, residency of tagged shad at the Vernon Project prior to passing upstream, efficiency of shad passage through the fish ladder, and perhaps numbers of post-spawned shad returning downstream through the Vernon Project. Another variable the 2012 study may assist with is selection of radio frequencies for this study. Analysis of those data may provide insight into which frequencies may be noisier, thus avoided, in the vicinity of the project. Timing of migration through the Turners Falls impoundment and residence time of tagged shad in the Vernon tailwaters during 2012 will help determine sample size for this study. Results of the analysis of the 2012 data will be discussed with the aquatics working group and critical modifications to the field work described below for the upstream passage assessment in this study will be discussed based upon this consultation.

TransCanada will monitor the timing of shad upstream migration through the upper portion of the Turners Falls impoundment as the 2012 study did, and monitor shad behavior and movement near-field to the Vernon turbine discharges and the spillway areas. This behavior will be correlated to turbine discharge regimes, and effects will be assessed. Ability of tagged shad to locate the fish ladder entrance will be assessed and related to project operations. Once in the fish ladder, efficiency of passage will be determined similarly to the 2012 study. PIT readers in the fishway, as well as one of the radio monitoring stations, will record shad passage. After passage at Vernon, timing of the shad migration as far upstream as the Bellows Falls Project will be determined. Tagged shad will be manually tracked and spawning areas located. Spawning will be observed and egg collections should yield measurable success evaluations. Emigration of post-spawned tagged shad will be evaluated and downstream passage routes as well as expediency of passage at Vernon Project will be identified. Passage survival through the project will be assessed with the use of motion sensor/temperature radio tags.

Methods used for this study will generally follow those requested by the agencies and NGOs, and are provided below. Using methods similar to those used in the 2011 and 2012 whole-river shad migration studies will aid in making comparisons between years and enhance the overall dataset. Use of radiotelemetry with PIT telemetry is widely accepted as the best method to assess fish migratory behavior and passage success; this method has been used extensively to assess migration and passage issues at Connecticut River projects.

Monitoring Stations and Receivers

Prior to releases of tagged individuals, radio-monitoring equipment and PIT readers will be set up at the Vernon Project. Similar to the prior USGS radio telemetry study, monitoring stations will be installed to monitor the fish ladder entrance, the immediate tailrace area, and a location just downstream of the tailrace (approximately 1.5 miles downstream of Vernon dam). In addition, two monitoring stations will be deployed to monitor the dam spillway and turbine discharge areas of the tailrace. In the immediate vicinity of Vernon dam, monitor stations will be configured to monitor tagged individuals to within 30 feet of the fish ladder entrance, in areas of the turbine discharges within 50 feet downstream, in the spillway within 100 feet downstream, and within the entire tailrace area to approximately 800 feet downstream of the dam (Figure 21-1).

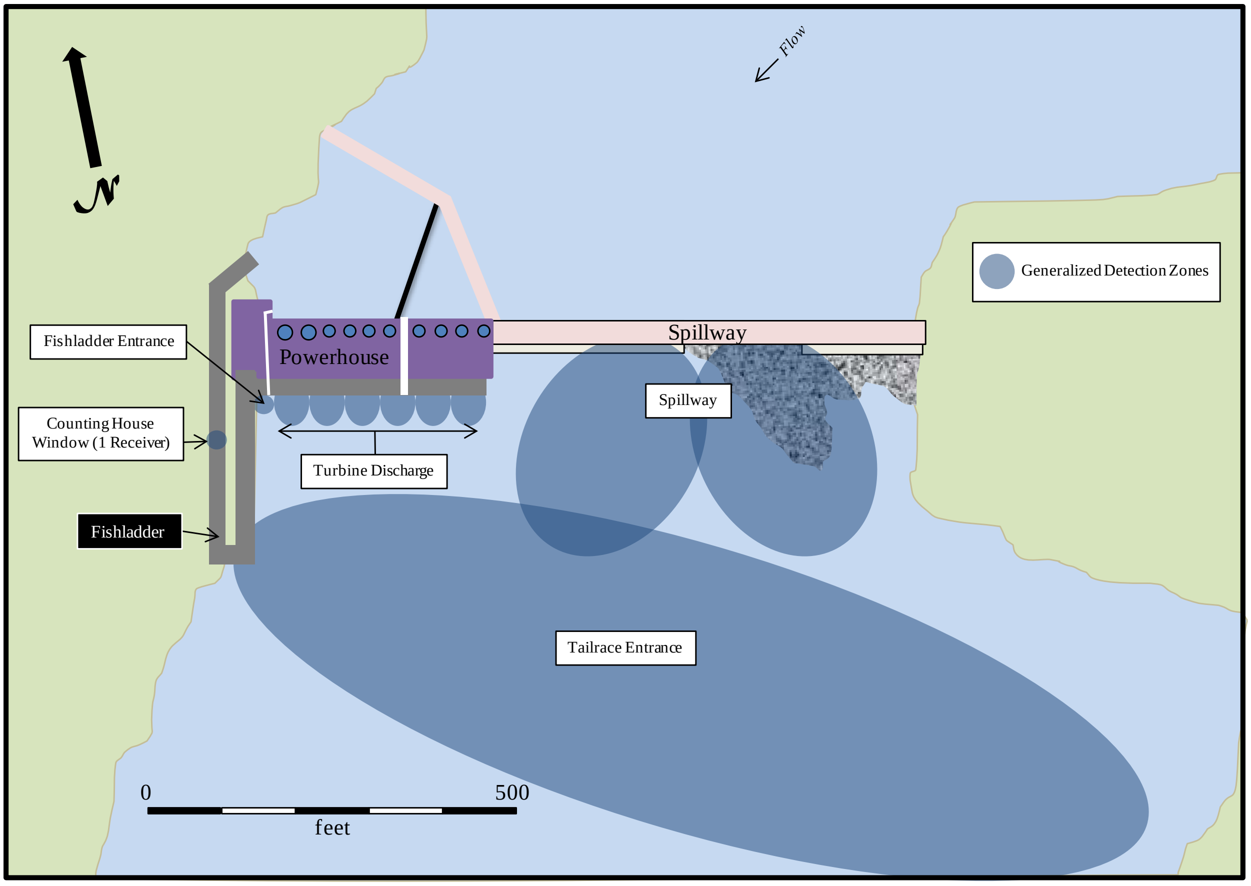

Figure 21-1. Detection zones for monitoring stations used to evaluate upstream movement of radio-tagged shad at the Vernon Project.

One monitor station will be configured to detect the presence of radio-tagged shad to within 30 feet of the fish ladder entrance. Within the ladder, tagged shad will be monitored near the counting room window to detect tagged shad passing upstream. The turbine discharge area will be monitored as depicted in Figure 21-1. Reception of these antennas will be configured to detect tagged shad within approximately 50 feet downstream of the dam and approximately 25 feet in either direction along the dam from each antenna. The spillway area will be monitored to differentiate if and where within proximity to the spillway tagged shad reside. Entrance into the tailrace area will be monitored. Coverage will include a large portion of the tailwaters and the entire width of the river. The number of tagged shad that are recorded on this monitor, remain in the tailrace for at least 2 hours (or pass up the ladder), during a period when the water temperature is <21°C (Facey and Van Den Avyle, 1986) will comprise the denominator for estimating fish passage effectiveness.

The monitor station located downstream of the dam (identified as "Vernon downstream") will be configured to detect tagged individuals within 400 feet downstream and upstream of that station over the entire width of the river (Figure 21-2). An additional receiver will be installed in the counting house of the Vernon fish ladder to confirm presence within the ladder via radiotelemetry. A monitor station will also be installed approximately 0.75 mile upstream of Vernon dam to monitor continued upstream migration.

PIT readers will be installed at five locations within the fish ladder. An antenna will be installed in the first bay of the ladder to denote the entrance of an individual. Other antennas will be deployed at the first bend of the ladder, near the counting house window, just upstream of the window where the ladder becomes vertical slot, and at the exit.

Two monitoring stations will be deployed at the Bellows Falls Project to detect radio-tagged shad that may arrive in the tailwaters (Figure 21-2).

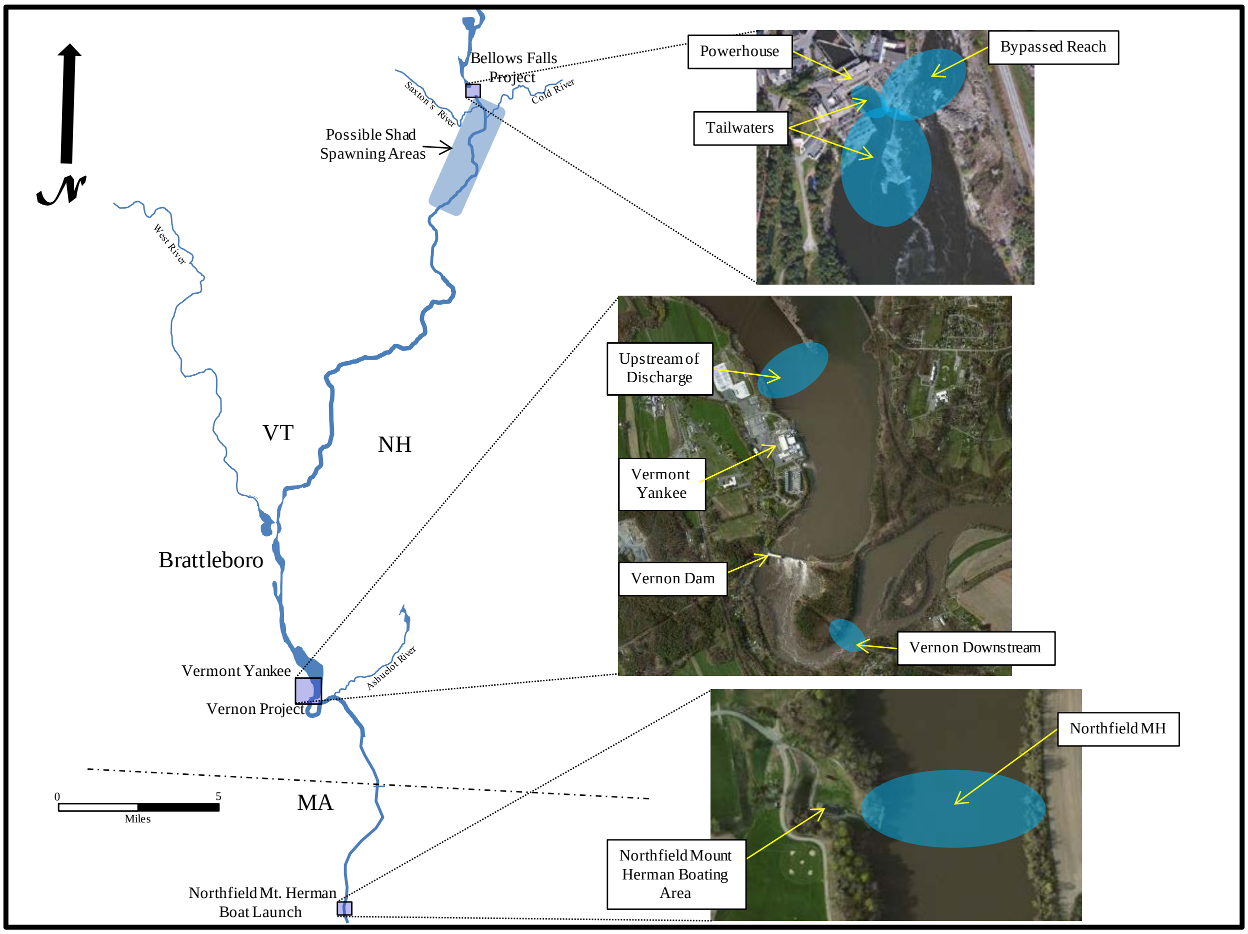

Figure 21-2. Diagram depicting detection zones of monitoring stations upstream and downstream of the Vernon Project.

The immediate upstream area of Vernon dam will be monitored with three monitoring stations (Figure 21-3). They will be configured to discretely monitor the intakes, the fish bypasses, and the spillway area of the dam. Post-spawned, radio-tagged shad will be monitored emigrating past the dam, and route selection will be determined. A PIT antenna will be installed on the bypass fishpipe exit to monitor PIT-tagged (nonradio-tagged) shad that may exit.

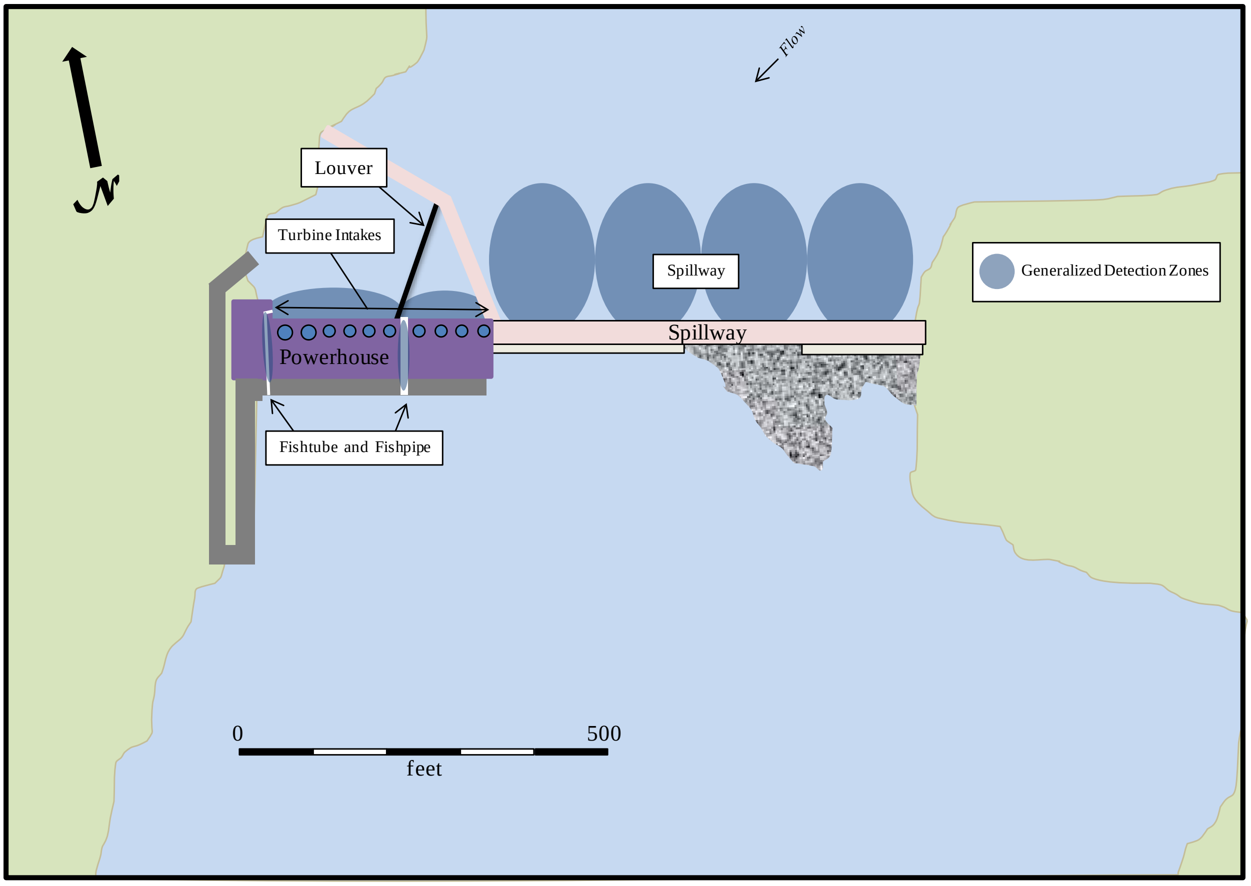

Figure 21-3. Detection zones for monitoring stations used to evaluate downstream movement of radio-tagged shad at the Vernon Project.

Radio receivers will be Lotek Wireless, Inc. (Lotek) SRX_400 and SRX_600 units and a Digital Spectrum Processor data logging unit. Radio transmitters will be coded VHF transmitters supplied by Lotek, Newmarket, Ontario, Canada. The radio tags (model number MCFT-3EM) are digitally encoded and will transmit signals on two to four frequencies (channels) within the 150- to 151-megahertz band. Each radio tag will contain a unique pulse train to allow for individual fish identification (codes). Each cylindrical radio tag measures 11 mm in diameter, 49 mm in length, weighs 4.3 grams in water, and has a 455-mm-long whip antenna. The radio tags will propagate signals at varying rates between 2.0 and 3.0 seconds and will have a minimum battery life of approximately 206 days. Each tag will incorporate motion and temperature sensing capabilities. If a specimen becomes stationary or regurgitates its transmitter, detection of that signal will verify via pulse code that the transmitter is stationary. In addition, every detection event of radio-tagged shad will record its temperature within the data log. Temperature and motion data are transmitted via pulse codes, thus, can only be discerned during detection of the radio signals.

PIT readers will be half-duplex units identical to those used for the 2012 USGS study. PIT tags will be 32 mm half-duplex Model RI-TRP-WR2B-30 read/write, Texas Instruments, Austin, TX.

Tagging

American shad will be collected at the Holyoke fishlift and the Vernon fish ladder for tagging as follows:

1. Fifty specimens will be taken at Holyoke, radio and PIT tagged, and transported to an area of the Connecticut River approximately 10 miles downstream of Vernon dam for release. The release site is located outside of the Vernon Project area, but it was selected to give radio-tagged shad sufficient area in which to recover from handling and continue volitional upstream migration. Specimens will be tagged by inserting the radio tag through the mouth and esophagus and placing it in the stomach. They will be PIT tagged by placing the tag through a small incision made on the lower flank of the fish.

2. Another 50 shad will be only PIT tagged at the Holyoke fishlift, transported upriver, and released at the same area of the Connecticut River 10 miles down from Vernon dam. These 50 fish plus those in the dual-tagged group above that arrive at Vernon and want to pass upstream will be sufficient to monitor fish ladder efficiency. This sample size may also be supplemented with radio-tagged shad released by FirstLight under a similar study. Fallback is an issue inherent with American shad tagging studies. Handling of fish to tag induces stress and some proportion of the sample may move downstream after release, prior to moving back upstream; some may not move upstream at all. Castro-Santos (2011) noted 90 percent of his radio-tagged shad arrived at the lower boundary of this plan’s study area below Vernon from Turners gatehouse in 2011. TransCanada proposes to tag shad with methods similar to those used by Castro-Santos.

3. Another 50 shad not previously tagged will be collected from the Vernon fish ladder. These will be radio-tagged and released upstream of Vernon dam. These fish, supplemented by those in the dual-tagged group above and any fish from FirstLight’s study that pass upstream of Vernon, will be used for the spawning portion of the study.

Shad will be tagged and released in lots of 20, 20, and 10 both below and above Vernon Project to reflect the early, mid, and later portion of the shad migration period. The PIT-tagged shad will be tagged and released similarly. TransCanada believes that these sample sizes and receiver configurations, supplemented by expected FirstLight fish, are sufficient to achieve the goals and objectives of this study, balanced by the potential loss of data due to signal collisions inherent in larger sample sizes.

If analyses of the USGS 2012 data suggest a greater sample size may be needed to gain meaningful information, sample sizes for PIT and radio/PIT tagged shad (and the number of receivers needed to accommodate larger sample sizes to minimize signal collisions) will be increased to a level that to ensure collection of significant data.

TransCanada will share radio-frequency information with FirstLight and expects that FirstLight will share its frequencies to ensure that tagged fish that move from the Turners Falls Project upstream into the Vernon Project or vice versa will be monitored.

Tracking

Radio-tagged American shad upstream and downstream (if present) of Vernon dam will be manually tracked using a boat, car, and/or aircraft if shad cannot be located otherwise, and their locations will be recorded for each tracking event. The stretch of river between Vernon and Bellows Falls will be tracked every other day. Once the tagged fish appear to be congregating and holding around areas that appear suitable for spawning, and once water temperatures are conducive, those areas will be manually monitored, and nighttime observation periods will commence.

Observation trips will take place every other night one night below Vernon dam and the next night between Vernon and Bellows Falls dam. Observation periods will commence prior to dusk and continue until all spawning activity has ceased for 30 minutes. Nighttime visual observation of spawning activity will include identifying and defining areas geospatially and obtaining data about physical habitat conditions and project operations (e.g., water depth, velocity, discharge, substrate, exposure, and inundation of habitats). If observations suggest that shad are spawning, ichthyoplankton nets will be set and towed downstream of the suspected spawning activity to collect eggs. All sampling events will be documented with date/time, location, water temperature, substrate type, average depth, water velocity, and pertinent comments.

ANALYSIS

After all telemetry data collected by USGS during its 2012 study that is pertinent to the Vernon Project are made available to TransCanada, the data will be compiled, reduced, sorted by individual, and analyzed to provide, to the extent the data allow, a concise representation of migrating shad movement and behavior in the tailrace area of Vernon dam. Depending on the quality of the data, migration routes, residency times, ladder efficiencies, and effects of project operations on passage efficiency will be ascertained. If data are conducive to determining downstream passage of post-spawned shad, they will be analyzed to discern success of downstream passage as well.

For this study, all radio transmitters will have a unique frequency or code, thus allowing discrimination by individual. In addition, temperature sensors incorporated within the transmitters will allow the fish's ambient temperature to be recorded when individual is being detected. The motion sensing ability of the transmitters will be an instantaneous measure of the transmitter's mobility status (i.e., in the fish or not). All radio-telemetry data from each monitor station will be combined, compiled, reduced, and sorted by individual shad. Pertinent data made available from the related FirstLight study will be incorporated into the TransCanada dataset associated with this study.

Resultant refined data will illustrate individual shad movement and ambient water temperature about Vernon dam tailwater areas and indicate holding areas, if any, and timing of upstream passage. PIT readers within the fish ladder will supply information as to the efficiency of the ladder to pass shad. Locations of each radio-tagged shad will be presented spatial-temporally in tabular and graphic form, both in and around Vernon dam and upstream in the Vernon impoundment and Bellows Falls downstream reach. Project operational data will be presented and compared to shad movement to determine effects on shad movement and passage at the dam. The spawning location of each fish within the study area, if applicable, will be identified. Water temperature data recorded by the radio tags and by data loggers set for the Water Quality Study (Study 6) will be presented in context with shad location and project operations.

Congregation and spawning areas of radio-tagged American shad will be compiled and presented graphically on maps and possibly with aerial photography. Quantification and qualification of shad egg collections will be presented in tabular form. Density of eggs collected per sample will be determined by enumerating a sub-sample and relating that to the volume of water filtered. Spawning activity and fervor will be described subjectively and relative to other spawning activities observed. Factors affecting egg collection (i.e., water turbulence, high velocities, shallow depth) will be noted.

Emigration timing, residence time, passage route selection, and survival of passage for each post-spawned shad will be presented in tabular form. Shad presence and timing of passage will be related to project operations data to characterize what project effects, if any, on downstream passage can be discerned. Temperature sensors will indicate water temperatures each tagged shad occupy as they migrate about the forebay area prior to downstream passage. Motion sensors will immediately identify the status of each transmitter, whether it is mobile or stationary after passage. Attempts will be made to discern whether the fish regurgitated the tag or whether it suffered mortality after downstream passage.

In order to gage the effects of project operations on shad spawning, collected data will be analyzed and compared to project operational data. The times and dates of all observed spawning activities, substrate description, water measurements (i.e., velocity, temperature, DO, pH, conductivity, and turbidity), and observational characteristics or anomalies (e.g., extensive water roiling or turbulence) will be recorded and related to the operational data (e.g., total generation, turbine operations, and spill at the particular project in question—Bellows Falls or Vernon).

Observed effects of project operations on spawning activity will be classified per operational regime observed as:

1. no effect –no observable effect on spawning; viable eggs were collected;

2. moderate effect – observable possible effect on normal spawning activity; spawning may have been hindered but viable eggs were collected; and

3. adverse effect – project operations likely to have prevented successful spawning of shad; no viable eggs were collected.

Effects classified as 2 or 3 will be correlated to data in the HEC-RAS model in the Hydraulic Modeling Study (Study 4) specific to that location in an attempt to characterize the relative level of project effects from non-project effects that contribute to potential adverse effects at the specific sites. To the extent possible and based on the assessment of the entire spawning dataset, an attempt will be made to identify and characterize if any of these effects are likely to be persistent throughout available shad spawning habitats.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The study methodology is consistent with generally accepted practices. The radiotelemetry of American shad has been conducted and accepted for many years. Shad spawning observations and egg collections during and after spawning follow acceptable practices and also have been widely conducted for years.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study, as well as results of passage efficiency at Vernon fish ladder and an assessment of project operational flows and elevations on spawning activity. A final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report, and an explanation of any stakeholder comments not incorporated will be provided. Study related data will be made available to stakeholders upon written request.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

Analyses of all data from USGS 2012 shad migration study related to the Vernon Project is expected to be completed by the end of 2013,[2] prior to the first year of this study.

Field work for this study will occur in the first study year (2014). American shad collection and tagging will likely commence at the Holyoke fishlift from mid-April to early May, depending on water temperature. All specimens should be tagged and released by early June. Shad will be monitored at Vernon dam and tailwaters, and once most specimens have passed upstream and arrived at spawning sites, as

[2] This assumes timely delivery of data (e.g., by September).

determined by monitoring, by mid- to late-June, field observations and egg collections will commence. The field observations will likely end in early to mid–July when specimens should begin to emigrate. Most post-spawned shad can be expected to pass downstream of Vernon dam by late July. Data compilation, reduction, analyses, and report preparation will be conducted after the end of the field season.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this study is $258,000, pending analysis of the 2012 USGS data and additional working group consultation.

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REVISED STUDY 22

DOWNSTREAM MIGRATION OF JUVENILE AMERICAN SHAD – VERNON

RELEVANT STUDY REQUESTS

FWS-06; NHDES-26; NHFG-26; VANR-09; CRWC-24; TU-09

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHFG, VANR, CRWC, and TU identified a potential issue related to the Vernon Project's operations on downstream passage of juvenile shad. The issue identified is whether or not project operations affect juvenile shad outmigration and production.

The study goal is to assess whether project operations affect the safe and timely passage of emigrating juvenile American shad.

The specific objectives of this study are to:

- assess project operation effects on the timing, route selection, migration rates, and survival of juvenile shad migrating past the project;
- characterize the proportion of juvenile shad using all possible passage routes at Vernon over the period of downstream migration under normal operational conditions; and
- conduct controlled turbine passage survival tests for juvenile shad passed through one of the older Francis units (Unit Nos. 1 to 4) and one of the new Kaplan units (Unit Nos. 5 to 8) to estimate the relative survival specific to those unit types.

This study, in conjunction with a previous juvenile American shad turbine survival study of Unit 10 (Normandeau, 1996), will provide the information to evaluate whether turbine passage adversely affects juvenile survival and also provide information to evaluate migration timing and forebay residency time.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS	• Specific goals related to American shad including minimizing project effects on juvenile shad survival, production, and recruitment. Goals reference ASMFC Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (ASMFC, 2010) and CRASC Management Plan for American

Shad in the Connecticut River (CRASC, 1992).

- General goals for relicensing including ensuring that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives and conserving, protecting, and enhancing habitats for fish, wildlife, and plants affected by the projects.

NHDES

- State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.

NHFG

- NHFG specific goals related to American shad including minimizing project effects on juvenile shad survival, production, and recruitment. Goals reference ASMFC (2010) and CRASC (1992).
- General goals related to healthy ecosystems to support fish and wildlife. Goals reference the New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR

- VFWD specific goals related to American shad including minimizing project effects on juvenile shad survival, production, and recruitment. Goals reference ASMFC (2010) and CRASC (1992).
- State water quality standards for designated uses of Class B waters relative to levels of water quality that fully support aquatic biota and habitat.
- General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.
- General goals for relicensing including ensuring that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives and conserving, protecting, and enhancing habitats for fish, wildlife, and plants affected by the projects.
- VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them and providing fish- and wildlife-based activities including viewing, harvesting, and

utilization of fish, plant, and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005).

- VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety. Goals reference the Vermont Fish and Wildlife Strategic Plan (VFWD, 2006).

ASSOCIATION WITH OTHER STUDIES

This study is not directly associated with any other studies, although temperature data collected in Water Quality Monitoring (Study 6) will be used to help characterize the overall temperature conditions during juvenile shad emigration.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Adult shad are counted annually as they pass above Vernon dam. Juvenile American shad production has been monitored upstream and within approximately 0.5 mile downstream of Vernon dam by Vermont Yankee as part of an annual monitoring program, using both boat electrofishing (since 1991) (Normandeau, 2012) and beach seining (since 2000) (Normandeau, 2013). A seasonal average annual index of juvenile American shad standing crop in the portion of the lower Vernon impoundment (from RM 141.9 at Vernon dam to the West River confluence at RM 149.3) has been calculated since 2000 (Normandeau, 2013). Estimates of juvenile shad growth rates have varied from 0.26 to 0.79 mm per day (Normandeau, 2013). Additionally in a study conducted in 1995 (Smith and Downey, 1995) in the Vernon reservoir and upper Turners Falls impoundment, the combined average growth rate observed was 0.75 mm per day.

Studies of American shad passage were conducted in 1991 and 1992 with tests of a high frequency sound field to guide fish to the fish pipe, the primary downstream fishway (RMC Environmental Services, Inc., 1993). Although the high-frequency sound studies were deemed inconclusive, a behavioral response by juvenile shad to the sound pulses was observed in some tests.

In 2009 following the replacement of Units 5 through 8, the feasibility of using a fixed aspect hydroacoustic array to evaluate passage routes selection by juvenile shad was studied (Normandeau, 2010). The study included the deployment of transducers on the downstream face of the trashracks, 'looking' into the turbine intakes, and a limited collection of data. The configuration of the turbine unit intake bays limited the volume that could be sampled, and there were significant amounts of entrained air that confounded juvenile shad target detection. Due to these limiting factors it was concluded that an adequate assessment of turbine entrainment (relative route selection) with this tool in this configuration was not feasible.

Passage survival of juvenile shad through Vernon's Unit 10 (a Francis turbine) was estimated in a study conducted in the fall of 1995. All recaptured fish were alive, and the immediate (1-hour after passage) estimate of relative survival was 94.73 percent. The latent survival estimate was 94.61 percent. The precision on the estimates was within ±10 percent for 95 percent of the time (Normandeau, 1996).

PROJECT NEXUS

The falls at Bellows Falls, Vermont, is recognized as the historical upstream limit of migration for American shad in the Connecticut River (Langdon et al., 2006). Spawning between Vernon dam and Bellows Falls dam is known based on the production of juvenile shad in the Vernon impoundment (e.g., Normandeau, 2013). Limited information is available regarding the overall effect of the Vernon Project on downstream migration of juvenile shad. Project operations may influence the downstream passage route selection, forebay residency time, and predation and mortality of juveniles during passage under varying flow conditions.

STUDY AREA AND STUDY SITES

The study area encompasses the Vernon Project forebay, tailrace, turbines, bypass fishways, and dam.

METHODS

Due to the configuration and specifications of the Vernon Project and the potential limitations inherent in working with juvenile American shad, no single monitoring tool will provide the necessary information for this study. Therefore, the use of multiple tools will ensure that study objectives are met.

The methods in this study include radiotelemetry, HI-Z Turb'N tag, and hydroacoustics, as requested by the agencies. The methods do not include the use of PIT tags or underwater video. Because the turbine units and possibly other routes, could not be set up with PIT tag antennas that would sample with high detection probabilities, the use of PIT tags would provide little additional information for determining passage route selection, survival, or overall run timing. At best, only the fish bypasses (and possibly the sluice) would be conducive to installing a PIT-tag reader, and because the fish pipe is of steel construction and tagged fish would be moving through them at very high velocities, effective PIT tag antenna installation would also be problematic in these routes. TransCanada has determined that underwater video is no longer needed with the addition of hydroacoustics.

Radiotelemetry of juvenile shad will provide information on forebay residency time and proportional passage route selection. Radio-tag size has become smaller in recent years and is now suitable for juvenile American shad. This tool has been used with juvenile American shad for several other studies (e.g., recently on the Susquehanna River). The HI-Z Turb'N tag methodology (Heisey et al., 1996) is the most effective approach to estimate the direct survival of fishes that pass through hydro turbines or spill structures. The methodology was developed in the early 1990s in large part to evaluate turbine passage survival of juvenile American shad at Susquehanna River projects. Due to the relatively large size of the river and the hydro projects, no other conventional tool was effective at the time for juvenile American shad (due to their small size and fragile nature).

A single beam hydroacoustic transducer will also be used to monitor in the forebay in the vicinity of the downstream fishpipe. (Note that Vermont Yankee has also submitted a study proposal to VANR to monitor juvenile shad downstream movement through the Vernon impoundment via a hydroacoustic array located in the forebay of Vernon dam). For this study, this method will provide additional qualitative information on the timing, duration, and relative abundance of the American shad downstream migration. This method can provide quantitative estimates of abundance of those fish detected within the acoustic beams, but cannot provide a quantitative estimate of absolute abundance or magnitude of the entire run. Periodic net sampling will be used to verify the species and size composition of the acoustically detected shad. Collectively, the use of these various tools should provide the information needed to evaluate whether juvenile shad pass Vernon dam in a safe and timely manner.

Run Timing and Route Selection

The duration and timing of the juvenile shad downstream migration will be characterized through monitoring the bypass with a single-beam hydroacoustic transducer located in the forebay near the downstream fishpipe. Placement will be selected to optimize detectability given beam geometry and properties, as well as locations where shad are likely to occur regularly in highest abundance. To confirm the presence of juvenile shad, visual observations will be made twice per week. In addition, a lift net will be used to sample fish in the forebay for size characterization. Monitoring will occur from approximately early September through approximately the end of October. Monitoring will be triggered when river temperature decreases to 19°C (O'Leary and Kynard, 1986) and be terminated when juvenile shad are no longer observed or the river temperature reaches 5°C, whichever occurs first.

The proportional route selection and forebay residency time for juvenile shad downstream passage will be assessed by radio-tagging and systematically monitoring tagged shad movement and passage through the project. Because fish for tagging should be at least 110 mm long, and there is purported availability of suitable test fish from a regional hatchery, that is the preferred source of fish for tagging portions of this study. Periodic monitoring of shad growth rates and, if necessary, supplemental feeding to increase growth, can be facilitated in a hatchery environment and thus better ensure that study objectives are met. If hatchery fish are not available, juvenile shad for this study will be collected at one or more of the following locations: via seining in a backwater area in Vernon Pool known as Cersosimo Pond (approximately 4.7 miles upstream of Vernon dam); Turners Falls Cabot Station bypass sampler; via seining upstream of Turners Falls dam near Barton Cove; or via seining in the Oxbow in Northampton, Massachusetts. Test fish procurement is expected to occur in late September to early October to coincide with the expected natural downstream migration period. Following collections, shad will be transported and retained in appropriate holding facilities in a secure location at the Vernon Project.

Remote telemetry monitoring will occur at the Vernon forebay, log boom and diversion boom, bypass fish tube, turbines, tailrace, and spillway. Radio receivers and/or digital spectrum processors (DSP) capable of monitoring multiple radio channels simultaneously at each location will be coupled with appropriate antennas and calibrated to ensure adequate coverage of the individual sites to be monitored while minimizing overlap between the sites. It is expected that, at a minimum, seven monitoring sites will be installed. Data downloading from the remote telemetry monitoring stations will occur at a minimum of three times per week. Periodic manual monitoring by boat will also occur to assist in data collection and analysis.

Radio transmitters for this study will be no more than 5 mm wide x 3 mm high x 14 mm long in size, weigh≤0.5 grams in air, have a calculated life of 8 days, and will propagate a signal via a flexible whip antenna. Each transmitter will contain a unique pulse code to allow for individual fish identification and DSP compatibility. The transmitters will be constructed or modified to allow for reliable secure external attachment to the back of each fish. For testing, 10 groups of 10 shad will be externally radio-tagged, transported by boat, and released approximately 1.5 miles upstream of Vernon dam over the course of the downstream migration season. It is expected that this release scenario will allow for monitoring over a range of environmental and project operating conditions. Only shad >110 mm total length will be used for the study. Additionally, each group of tagged shad will be released with a group of untagged shad to encourage schooling behavior.

During the course of the study, air temperature, water temperature, turbidity, rainfall, river flow, and project operations information will be collected and reported. Lunar phase will also be noted. To evaluate the potential for tagging effects, a simultaneous controlled experiment will be conducted (either simultaneously to the study or in the fall of 2013) by holding groups of tagged and untagged juvenile shad in tanks and making formal observations on their relative behavior. The objective of this experiment is to evaluate whether the tagging process and tag itself affect the behavior of shad relative to untagged fish. If behavior of tagged fish is affected by tagging, the results of the field tests could be biased. A dummy tag of the same specifications as the radio tags will be used on shad at least 110 mm in length. The tagged fish will be mixed with untagged fish. At least 20 tagged fish in each of two holding tanks will be mixed with at least 20 untagged fish in each of two holding tanks. Water temperature and DO will be continuously monitored in the tanks. In addition, 15 minute observation periods during late afternoon and evening periods will be randomly selected so that close observation and data recording can be conducted. At least twenty 15 minute observation periods per test tank will be conducted. Results will be compiled and included as an appendix to the report.

Turbine Survival/Injury

Turbine passage survival of juvenile shad will be assessed by using mark/recapture methodology at one of each of the two un-tested unit types (the smaller Francis turbines in Units 1 through 4 and Kaplan turbines in Units 5 through 8). As discussed above, one of the two large Francis turbines (Unit 10) was previously studied for juvenile shad passage survival (Normandeau, 1996).

Selection of the test turbine units will be based in part on historic operations being prepared as part of Study 5, Operations Model and on an evaluation of the turbine specifications and priority of operation. An evaluation of unit-loading conditions will be shared with the aquatics working group for comment prior to making final unit loading determination(s) for each set of released fish. As described in the Vernon PAD, Units 1 through 4 are single runner, vertical Francis turbines rated at 4,190 horsepower (HP) at 35 feet of head and 133.3 rpm with a maximum hydraulic capacity of 1,465 cfs. The new units, No. 5 through 8, are vertical axial flow Kaplan turbines with a 3.1-meter diameter runner rated at 5,898 HP at 32 feet of head, and 144 rpm with a maximum hydraulic capacity of 1,800 cfs. Units No. 9 and 10 are vertical single runner Francis turbines rated at 6,000 HP at 34 feet of head with a maximum hydraulic capacity of 2,035 cfs. The turbine intake trashracks are 2-inch on center for Units 1 through 8, and 4-inch on center for Units 9 and 10. During fish ladder operation, unit priority is Unit 10, followed by 8, 7, 9, 6, 5, 4, 3, 2, and 1. Outside of the fish ladder operating season unit priority is Units 5 through 8 first, followed by Units 9 and 10, followed by Units 1 through 4.

A minimum of 150 HI-Z Turb'N tagged juvenile shad will be released into one of the small Francis units and 150 into one of the Kaplan units. An additional 150 HI-Z Turb'N tagged shad will be released into the tailrace to serve as the control group for the turbine survival tests. Based on assumptions of 93 percent control group survival, 93 percent live recapture of fish, a sample size of 150 treatment group fish per test unit and 150 control group fish should yield a survival estimate with a precision of $\leq \pm$10 percent, 95 percent of the time. Survival tests will be conducted by injecting tagged shad into a turbine at or near full generation. Following release of treatment and control group fish, they will be recovered from the tailrace, examined for injuries, and held for 48 hours for observation and latent mortality. Unrecovered tagged shad will be censored from the data set.

ANALYSIS

Run Timing and Route Selection

The radiotelemetry data will be analyzed to determine the number and timing of shad using each monitored downstream passage route at the Vernon Project. A comparative analysis of passage routes with operations and environmental variables that occur during the study period will then be conducted. The analysis will include 2-D maps of movement and passage for each individual shad along with summarized data in tabular form. Forebay residency time by release group and for all release groups combined will be reported.

Hydroacoustic data will be evaluated for noise and air entrainment issues. If necessary, a filter will be applied to reduce or eliminate unwanted targets so that the desired targets (juvenile shad) will be more visible. When possible, hourly enumeration of targets will be included. If targets are so abundant that enumeration is not possible, estimates of the number of targets may be made by dividing the overall biomass estimate by an average target strength value for juvenile shad. While these counts will not be used to estimate the overall outmigration abundance, they can be used to characterize the relative abundance distribution over the course of the run.

Turbine Survival/Injury

Immediate (1 hour) and latent (24 hour) relative survival and classification of injuries will be estimated for each of the turbine types tested at the project using generally accepted practices (Normandeau, 1996). The results will be assessed in conjunction with the physical, environmental, and operating conditions that occur during the study.

An estimate of passage survival for the project in total will be calculated using proportional route selection data collected during the radiotelemetry portion of this study, and survival data from this study and the previous study of juvenile shad turbine survival through Unit 10 (Normandeau, 1996). In addition, the assessment will also take into account the unit preference and operating frequency or likelihood of unit operation.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The study methodology, data collection, and analysis techniques to complete the study objectives are consistent with generally accepted practices (Normandeau, 1996; Normandeau and Gomez and Sullivan, 2012).

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. A draft final study report will be provided after the study analysis is complete and the results are available. A report appendix will include all the relevant data for each individual fish. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This study will be conducted in the fall of the first study year (2014). The study report will be prepared after all field work and data analyses are completed.

LEVEL OF EFFORT AND COST

The preliminary estimated cost range for this study is $360,000 to $420,000 and is dependent in part on the effort required to obtain test specimens, based on the year-class success.

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REVISED STUDY 23

FISH IMPINGEMENT, ENTRAINMENT, AND SURVIVAL STUDY

RELEVANT STUDY REQUESTS

FERC-08; NHDES-18; NHFG-18; VANR-23

STUDY GOALS AND OBJECTIVES

In their study requests, FERC, NHDES, NHFG, and VANR identified potential issues related to Wilder, Bellows Falls, and Vernon Project operations on fish impingement, entrainment, and survival. The goal of this study is to assess the adequacy of the intakes at the projects to minimize fish mortality resulting from impingement and entrainment of fishes residing in the Connecticut River.

The objectives of this study are to:

- provide a description of physical characteristics of the Wilder, Bellows Falls, and Vernon Projects (including forebay characteristics, intake location and dimensions, approach velocities, and rack spacing);
- identify current routes of fish movement past each project and the risk of injury/mortality associated with each route (considering seasonality, flow direction and velocity, existing management regimes);
- analyze target species for factors that may influence vulnerability to entrainment and mortality;
- assess the potential for impingement and estimate survival rates for target species;
- assess the potential for entrainment and estimate survival rates for target species;
- estimate turbine passage survival rates;
- estimate total project survival considering all passage routes for American shad and river herring at the Vernon Project; and
- estimate total project survival considering all passage routes for American eel, Atlantic salmon, and sea lamprey at the Wilder, Bellows, and Vernon Projects.

As requested by FERC, these objectives will be accomplished through desktop analysis, not through field study as requested by other entities. This desktop analysis is not intended to quantify the contribution of project-related mortality to a calculated population estimate for individuals of a specific fish species, but rather, to provide a qualitative assessment of the potential for impingement or entrainment. Supporting data for this desktop analysis will be obtained through review of previously conducted studies at these and other projects, and currently proposed species-specific passage and survival studies at the Vernon, Bellows Falls, and Wilder projects.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

NHDES	• State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	• General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference the New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).
VANR	• State water quality standards for designated uses of Class B waters relative to high levels of water quality that support healthy aquatic communities and associated uses such as fishing.
	• General goals relative to aquatic natural resources including providing for healthy, self-sustaining fish communities and minimizing potential effects of project operations on resident fish populations.

ASSOCIATION WITH OTHER STUDIES

This study will rely on fish community data collected during the Fish Assemblage Study (Study 10). Fish community data from that study will be used to identify the target species list that will be assessed to identify potential impingement and entrainment effects. In addition, findings from the two American shad studies at the Vernon Project (Studies 21 and 22) and from the two American eel downstream assessments (Studies 19 and 20) may provide useful insight into the determination of survival for these diadromous fish species.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Numerous studies of passage route entrainment for anadromous fish are available (Hanson, 1999; Normandeau, 1995a, 1996a, 1996c, 1996d, 2009a; RMC, 1990, 1992b, 1993, 1994a). Previous mark-recapture balloon tag studies have assessed survival of Atlantic salmon smolts passing via downstream bypasses at the Wilder

(RMC, 1992a), Bellows Falls (RMC, 1991), and Vernon (Normandeau, 1995b) projects and through turbine units at the Wilder Project (RMC, 1994b) and Vernon Project (Normandeau, 1996b, 2009b). Exclusion and guidance of Atlantic salmon smolts by a fish diversion structure at Bellows Falls has also been assessed (Normandeau, 1995a). In addition, survival and injury rates have been assessed for turbine-passed juvenile American shad at the Vernon Project (Normandeau, 1996a). With the existing information on passage survival and proposed studies related to passage survival, along with a characterization of the potential for entrainment of fishes in the three pools, a qualitative assessment of the effects of entrainment will be conducted.

PROJECT NEXUS

Potential effects of project operations and facilities include fish impingement on the trashracks and entrainment through the generating units. Fish moving downstream in the Connecticut River as part of their life cycle encounter the project dams and intakes. Similarly, fish species resident to the project impoundments may enter forebays and come into proximity to the intakes. These actions may result in exposure of fish to impingement or entrainment.

This study will help establish a baseline condition to assist in evaluating entrainment and impingement potential and the expected survival of those fish at each of the projects.

STUDY AREA AND STUDY SITES

This desktop assessment will examine fish impingement, entrainment, and passage through the Wilder, Bellows Falls, and Vernon dams and powerhouse structures, including spillways, downstream bypasses, and turbine units.

METHODS

The assessment of impingement, entrainment, and survival will be conducted as a desktop analysis. A list of target fish species representing species of conservation interest and all fish guilds will first be developed based in the baseline fish community data collected as part of the Fish Assemblage Study (Study 10).

The potential for impingement or entrainment will be characterized based on the relationship of site-specific intake characteristics along with swim speed and life history characteristics of target fish species and guilds. Site-specific factors likely to influence the potential for entrainment include intake location relative to shore and littoral habitat; prevalence of littoral species, clupeids, and obligatory migrants in the source water body; depth of project intakes; degree of water-level fluctuations; hydraulic capacity; water quality; and intake velocities. Each project will be assessed for these site-specific intake characteristics. This assessment will rely on intake velocities calculated using the velocity equation $Q = V*A$ where Q = flow rate (cfs), V = velocity (feet per second) and A = area (square feet). Life history characteristics and species-specific swim speed information for target fish species will be obtained from peer-reviewed literature. The likelihood of impingement or entrainment for a particular species-life stage will be qualitatively assessed through the comparison of site-specific intake characteristics to literature-reported swim speeds, body dimensions, and other life history characteristics.

A review of entrainment studies conducted at other hydroelectric projects (i.e., EPRI, 1997) will be conducted to derive entrainment rates for target fish species. EPRI (1997) summarized entrainment rate data for hydroelectric projects, which relied on full-flow tailrace netting to sample the entire flow passing from one or more units at a project. Partial flow sampling was not included in that database due to the higher potential for sample contamination as a result of collection of resident tailrace fish or net avoidance. Each of the 43 projects contained in the EPRI (1997) data compilation will be reviewed for similarity in project characteristics to Vernon, Bellows Falls, and Wilder. Following determination of appropriate project(s) for use as surrogates, available entrainment rate data will be summarized for the fish species-life stages of interest at the TransCanada projects. Literature-obtained entrainment rates will be combined with project-specific discharge data to generate qualitative assessments of potential of entrainment for target species at each of the projects.

Entrainment survival for target fish species will be estimated using data from survival studies conducted at the projects (Normandeau, 1995a, 1995b, 1996b, 1996e, 2009b; RMC, 1991, 1992a, 1994b), other hydroelectric facilities with similar characteristics (e.g., EPRI, 1997; Winchell et al., 2000), and the Franke blade strike probability equation (Franke et al., 1997). In addition to literature-based and calculated passage survival rates, results from studies conducted for this relicensing will be used, including concurrent site-specific mark-recapture studies—Downstream Migration of Juvenile American Shad at the Vernon Project (Study 22) and the American Eel Downstream Passage Assessment (Study 19). Where data are available, survival estimates obtained during the site-specific mark-recapture studies will be compared to literature-obtained and calculated passage survival rates to evaluate the precision of the three predictive methods. Survival rate estimates for target fish species will then be combined with estimated entrainment numbers to estimate fish survival through the turbine units at the projects.

Total project survival will be characterized for American eel, Atlantic salmon, and sea lamprey at the Wilder and Bellows Falls Projects and for American eel, American shad, Atlantic salmon, river herring, and sea lamprey at the Vernon Project. With the exception of species and life stages with known distributions among downstream passage routes (data to be collected from Studies 19 and 22), estimates of total project survival will be obtained based on the assumption that fish passage will be equal to the distribution of flow through all downstream passage routes at a particular project. Using available site-specific, literature-based, or calculated survival estimates for each downstream passage route, an estimate of total project survival for each applicable species-life stage combination will be calculated.

ANALYSIS

Results of this study, including probability of impingement, estimates of entrained fish survival through the project turbines, and total project survival will be summarized in tabular format. All data used in the development of those estimates will be provided in an appendix to the study report.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

A desktop approach has been previously used and is a widely accepted technique for the assessment of impingement, entrainment, and turbine survival as part of FERC relicensing. Examples include the Claytor Hydroelectric Project (FERC No. 739), Brassua Hydroelectric Project (FERC No. 2615), and the Santee Cooper Hydroelectric Project (FERC No. 199).

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This desktop assessment of impingement, entrainment, and turbine survival will be conducted during the second study year in the spring of 2015. It will rely on results from the Fish Assemblage Study (Study 10), which will be conducted during study year 1 and will allow for proper identification of the target fish species. In addition, findings from the associated studies referenced above (Studies 19, 20, 21, and 22) may provide useful insight into the determination of survival for diadromous fish species.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this study is $65,000.

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REVISED STUDY 24

DWARF WEDGEMUSSEL AND CO-OCCURRING MUSSEL STUDY

RELEVANT STUDY REQUESTS

FWS-13; NHDES-12; NHFG-12; VANR-27; CRWC-30; TNC-05

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHFG, VANR, CRWC, and TNC requested a study of the effects of the Wilder and Bellows Falls Project operations on the Dwarf wedgemussel (DWM) (*Alasmidonta heterodon*). Five objectives were stated in each study request: three were related to baseline population studies and long-term monitoring and two were focused specifically on the potential effects of flow regime/water-level fluctuations on mussel behavior or habitat. This study includes an adaptive, two-phase plan that meets the objectives of the study requests and will benefit from collaboration with the aquatics working group throughout the design and implementation of the study. The goals of this study are to:

Goal 1: Assess the distribution, population demographics, and habitat use of DWM in the Wilder and Bellows Falls Project areas. This goal has three specific objectives:

- **Objective 1 (Phase 1):** Conduct an initial survey of the 17-mile-long reach of the Connecticut River from Wilder dam to the upstream end of the Bellows Falls impoundment to determine the distribution, relative abundance, and habitat of the DWM;

- **Objective 2 (Phase 1):** Determine the best sites for quantitative mussel sampling in areas where DWMare known to occur in the Wilder and Bellows Falls Project areas and the reach surveyed for Objective 1; and

- **Objective 3 (Phase 2):** At sites identified in Objective 2, collect statistically sound and repeatable data, using quantitative methods, to determine density, age-class structure, and habitat for DWM and co-occurring mussel species.

Goal 2: Assess the influence of flow regime (which includes water-level fluctuations) on DWM, co-occurring mussel species, and mussel habitat. This goal has two specific objectives:

- **Objective 4 (Phase 2):** Observe and record behavior of DWM and co-occurring mussel species *in situ* during varying flow conditions; and

- **Objective 5 (Phase 2):** Assess the potential effects of flow regime on DWM and their habitat.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS	• DWM is a federal endangered species. The goal is species recovery for removal under the Endangered Species Act in accordance with FWS' Dwarf Wedge Mussel Recovery Plan (FWS, 1993) and Five Year Review Summary and Evaluation (FWS, 2007).
NHDES	• State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	• General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference the New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).
VANR	• DWM is a state-listed endangered species. Specific goals for rare, threatened, and endangered species include maintaining or increasing populations and maintaining, restoring, providing stewardship for, and conserving habitats and natural communities that support rare, threatened, and endangered species.

ASSOCIATION WITH OTHER STUDIES

Several other studies have objectives and methods that overlap with, or complement, this study. They will contribute toward a greater understanding of the effects of flow regime on aquatic resources in the study area. Related studies include the Tessellated Darter Study (Study 12), Aquatic Habitat Mapping Study (Study 7), Instream Flow Study (Study 9), Hydraulic Modeling Study (Study 4), and Operations Modeling Study (Study 5).

Phase 1 of this study can be completed independent of other studies. Phase 1 results may assist with site selection or the selection of which parameters to measure, map, analyze, or model for Studies 4, 5, 7, 9, and 12. Likewise, those studies may also provide important information regarding site selection, measured parameters, and analysis to meet Phase 2 objectives of this study.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

The Connecticut River is thought to contain the largest populations of the DWM in the world; they occur in three distinct areas of the river that have been referred to as the Southern, Middle, and Northern Macrosites (Nedeau, 2008, 2009). The Southern Macrosite is bounded by Bellows Falls dam to the south and Wilder dam to the north, a distance of about 42 miles within which DWM are thought to occur in a 35-mile-long reach from Charlestown to Plainfield with one tributary population in the Black River. The Middle Macrosite occurs in the reach between Wilder dam and Monroe, NH. Based on studies conducted from 1999 to 2011, it appears that no tributary populations exist along the Middle Macrosite and that DWMs are confined to a 16-mile-long reach from the Orford/Piermont line to Haverhill. The Northern Macrosite occurs in areas upstream from Moore dam to the now breached Wyoming dam.

In 2011, Biodrawversity conducted a freshwater mussel survey throughout the Wilder, Bellows Falls, and Vernon Project areas (Biodrawversity and LBG, 2012). This survey was semi-quantitative; the main goal was to assess the distribution, relative abundance, demographics, and habitat of the DWM in the project areas. Dwarf wedgemussels were generally found in the same areas where they had been found during previous studies. The 2011 survey did not include the 17-mile-long reach of the Connecticut River downstream from Wilder dam, where DWMs have been documented to occur (Nedeau, 2008). This is the longest reach in the Connecticut River from Holyoke dam (MA) to Fifteen Mile Falls (NH) that has not been surveyed in the last 15 years.

Most of the DWM studies conducted in the last 20 years in the Connecticut River were either qualitative or semi-quantitative. Therefore, there is no basis for determining population estimates or trends. In addition, very little quantitative data exist about age-class structure, and therefore recruitment, of the population. Data on population distribution, size, density, age-class structure, and habitat use and availability are essential for determining the status and viability of the DWM population. Resource agencies and other stakeholders want to gain a better understanding of potential effects of hydropower operations on DWMs.

The biggest knowledge gaps include lack of a repeatable, quantitative mussel monitoring program that can allow for an assessment of population trends, and a general lack of understanding of how flow regime and water-level fluctuations affect individual mussels, populations, and quality and quantity of habitat.

PROJECT NEXUS

DWM is federally listed as endangered and occurs in the Wilder and Bellows Falls Project areas. The species may also occur in the 17-mile-long reach of the Connecticut River between the Wilder and Bellows Falls Projects. Project operations may influence DWM population viability and habitat suitability in these areas. This study plan will document the distribution and status of DWM populations in these areas and allow for a better understanding of how flow regimes may influence DWM distribution, density, behavior, and habitat use.

STUDY AREA AND STUDY SITES

The study area includes the Wilder Project, Bellows Falls Project, and the 17-mile-long reach from Wilder dam downstream to the upper end of the Bellows Falls impoundment (approximately to Chase Island). Survey sites in the Wilder impoundment will occur within the 14-mile-long reach (from 27 to 41 miles upstream from Wilder dam) where DWMs were documented in 2011. Survey sites in the Bellows Falls impoundment will occur within the upper 17 miles (approximately from the Black River confluence to Chase Island) where DWMs were documented in 2011. In the 17-mile-long reach from Wilder dam to Chase Island, a minimum of one site per mile will be surveyed; sites will be selected in the field as described in the following methods section.

METHODS

This study will use a two-phase, adaptive, and collaborative approach to achieve the same basic goals and objectives stated in each of the study requests. The study plan focuses on objectives that can be met within a 2-year period, but specific methods are described for 2013 fieldwork (Tasks 1 and 2, and a pilot study for Task 4). Details for Tasks 3 through 5 will be developed and discussed after evaluation of the field data collected in 2013. The primary reason for a two-phase approach is that additional surveys are needed to determine where DWM densities are high enough to permit quantitative sampling, behavioral studies, or analyses that combined DWM data with physical habitat modeling to assess potential effects of flow regimes. The goals and objectives of the DWM study align with those of several other studies, and the planning and implementation of those studies would benefit by having better information on where, at what density, and in what habitat DWMs occur. The 2011 survey did provide some of these data, but only detected low-density populations where certain types of quantitative sampling and habitat analyses may not be effective.

- **Phase 1 (2013):** Addresses study objectives 1 and 2, which both relate to baseline mussel studies and an evaluation of potential areas where more intensive quantitative sampling and flow-related studies may be conducted. Specific methods for a Phase 1 study are outlined in this study plan, under Task 1 and Task 2. Phase 1 will also include a pilot study of *in situ* monitoring (Task 4) to begin to address study objective 4.

- **Phase 2 (2014)**: Addresses study objectives 3 through 5 and will rely on Phase 1 data and working group input to determine where and how the necessary data may be collected. Therefore, aside from the pilot study for Task 4, this study plan provides only general details on methods for Phase 2 data collection or analyses, under Tasks 3 through 5.

Task 1. Semi-quantitative Survey from Wilder Dam to Chase Island

Methods for this task are similar to those used in the 2011 survey of the Wilder, Bellows Falls, and Vernon Project areas (Biodrawversity and LBG, 2012) but with the flexibility to spend additional time in high-quality habitat to simultaneously accomplish Task 2 objectives.

A minimum of 17 sites will be surveyed in this reach. Survey sites will be selected based on prior mussel survey data and the presence of habitat conditions likely to support DWM. Further, sites will be selected to ensure adequate spatial coverage of survey sites within the study reach.

Survey methods may vary according to habitat conditions at each survey site, but generally, surveys will be conducted by SCUBA diving. Snorkeling may be used in shallow areas. A minimum 1-hour, timed search will be conducted at all survey sites with more time spent in high-quality habitat where DWM are found.

The following information will be recorded at each survey site:

- species richness;
- precise counts of target species (DWM) and uncommon non-target species. These results will be reported as raw counts and CPUE;
- abundance estimates of non-target common species and size ranges of live animals;
- shell lengths and shell condition (i.e., degree of shell erosion) for each DWM and also for a subsample of other species;
- microhabitat (water depth, substrate, flow conditions, submerged aquatic vegetation, woody debris, and distance to shore) for each DWM;
- incidental observations of tessellated darters;
- general habitat descriptions will be recorded for each survey site and also for the broader areas near each survey site (i.e., a reach or segment);
- GPS locations for each survey site; and
- digital photographs of habitat, live animals or shells, and other features.

Task 2. Assess and Select Sites for Quantitative Mussel Surveys and Flow-Related Mussel Studies

This task will examine data collected during the 2011 surveys in the Bellows Falls and Wilder impoundments (Biodrawversity and LBG, 2012), data collected from 1990 to 2010 for these same reaches (Nedeau, 2008, and references therein), and the 2013 mussel survey from Wilder dam to Chase Island.

Based on these data, sites likely to have the largest DWM populations and the most available suitable habitat will be determined and assessed for the degree of flow regime alteration at each site.

These survey sites and/or nearby reaches will be revisited to gain a better understanding of the following: 1) spatial extent of the DWM population, 2) population densities of DWM and other species, 3) habitat use by DWM, 4) habitat suitability for DWM, 5) environmental conditions (especially sampling constraints), 6) accessibility (including potential property rights issues), and 7) any other factors that may influence whether a site could be used for further study.

Items 1 through 4 above will be determined by SCUBA diving or snorkeling both cross-channel and longitudinal transects; the number of transects will vary according to conditions at each site. For each transect, the following data will be recorded:

- precise counts of target species (DWM) and uncommon non-target species. These results will be reported as raw counts and CPUE;
- abundance estimates of non-target common species;
- shell lengths and shell condition (i.e., degree of shell erosion) for each DWM and also for a subsample of other species;
- incidental observations of tessellated darters;
- microhabitat (water depth, substrate, flow conditions, submerged aquatic vegetation, woody debris, and distance to shore) for each DWM and for the entire transect; and
- GPS locations for stopping and starting locations of each transect.

A written summary will include the following: 1) complete rationale for the initial screening process, 2) summary of mussel data and habitat data gathered at each of the sites, 3) summary of environmental and logistical constraints to accessing or surveying each site, and 4) recommendations for monitoring sites.

Task 3. Quantitative Mussel Sampling at Selected Sites

Quantitative sampling using a statistically sound and repeatable study design, with the goal of estimating mussel density and population size with a measure of variance, was an objective of all six study requests. In general, a mussel study should be guided by five considerations: 1) what are the objectives, 2) what is the target population, 3) what resources are available, 4) what is known about the study site, and 5) what is known about the mussel population (Strayer and Smith, 2003). Objectives should be defined in quantitative terms to help inform specific details of methods, such as sampling size.

Based on currently available information, it is premature to propose a specific study design or methods for quantitative monitoring. First, objectives need to be more explicit and quantitative. The target population (e.g., where, when, and what) must be better defined. Currently, there is no way to select study sites because the qualitative and semi-quantitative studies performed to date have not provided adequate data. In fact, based on currently available data, DWM population densities in the project areas may be too low for some types of quantitative monitoring (Gabriel, 1995; Strayer and Smith, 2003). Lastly, environmental conditions and other sampling or access constraints must be assessed before survey sites can be selected. TransCanada will work with the aquatics working group to address these considerations after Task 1 and Task 2 results have been summarized and submitted for review. The goal will be to establish three sites where quantitative sampling and behavioral studies may be most effective: one in the Wilder impoundment, one in the Bellows Falls impoundment, and one in the 17-mile-long reach between the Wilder and Bellows Falls Project areas.

A variety of quantitative study designs have been proposed and tested on DWM populations and other riverine mussel species (Strayer and Smith, 2003). Study requests specifically mentioned systematic quadrat sampling with multiple random starts and double sampling (i.e., substrate excavation); this was described in Strayer and Smith (2003) and used in the Ashuelot River (NH) for long-term monitoring of DWM populations (Nedeau, 2004, 2006; Biodrawversity, 2012, 2013a). Variations of this approach have also been used in lakes (Biodrawversity 2009) and large rivers (Biodrawversity 2013b) in the Northeast. It is very likely that some variation of this study design will be most appropriate for Task 3. This study design is also effective at determining spatial distribution and microhabitat of target species, particularly when key location and habitat parameters (e.g., water depth, flow velocity, and substrate) are recorded concurrently with the mussel data (Nedeau, 2004, 2006; Biodrawversity, 2012, 2013a-b). Shell length, age estimates, shell condition (degree of shell erosion), and gender of mussels would also be recorded during quantitative sampling to document age/size structure, recruitment success, individual condition, and sex ratios.

In low density mussel populations, quantitative sampling using quadrats may be difficult to implement because detection probability is low, and very large numbers of samples (i.e., quadrats) may be needed to achieve adequate statistical power (Strayer and Smith, 2003). In these cases, investigators have used less rigorous quantitative study designs such as transects, or semi-quantitative study designs such as timed searches (or some combination of the two). The pros and cons of these approaches were described specifically for the DWM population in the Connecticut River in a 1995 report (Gabriel, 1995). Although transects or timed searches are inferior to quadrat sampling from the standpoint of repeatability and precision, they do typically detect a higher number of animals and may provide better information on habitat use and population demographics. Gabriel (1995) recommended intensive timed searches of transects to provide comparable indices of DWM population density, size class distribution, and possible changes in the locations of mussel beds.

Overall, this study plan aims to find areas where quantitative sampling using quadrats will be effective. If DWM are not found, or if there population densities are too low for this design to be effective, some variation of the transect and timed search study design, as described in Gabriel (1995), will be developed. This is similar to what is described under Task 2, except with greater replication, and only in areas that are selected using the Task 1 and Task 2 results.

Task 4. Observe and Record Mussel Behavior *In Situ* at Varying Flow Levels

In situ observations of mussel behavior at varying flow levels were included in each of the study requests. As described in the study requests, biologists could "measure changes in shell position (open/closed), siphoning rate, lure display, horizontal migration (movement across the substrate), and vertical migration (burrowing) due to flow fluctuations" by observing individual mussels. There are myriad challenges to this type of monitoring. Very few case studies provide guidance on where and under what conditions *in situ* observations might be effective, how to collect data, how to minimize observer effects, how to separate natural behavior from behavior related to a stressor of interest, how to interpret the data, and what conclusions can be drawn about individual mussels or populations from short-term observations of behavior. Furthermore, there are no known locations in the project area where DWM densities are high enough that multiple individuals could be observed in the field of view of a biologist or camera, raising concerns about level of effort to adequately replicate behavioral observations while controlling for confounded variables.

Due to these challenges, this study plan proposes a two-phase approach. First, a pilot study will be conducted in 2013 to observe mussel bed(s), preferably with DWM present, during the rising and falling limbs of daily flow fluctuations. Behavior will be observed and recorded with an underwater video camera. The mussel bed(s) will occur in relatively shallow water in area(s) of the river where peaking flows are more acute, probably in the upper Bellows Falls impoundment or the reach downstream from Wilder dam. A summary of observations, along with an assessment of whether this type of monitoring might be feasible at a larger scale, will be developed and shared with the aquatics working group. Based on results of the pilot study, a second phase may be developed, discussed with the working group, and implemented in 2014. The second phase would likely be an expansion of the pilot study, but done in a more repeatable way and in areas where mussel populations and habitat conditions are conducive to *in situ* monitoring. Task 1 and Task 2 results will be needed to determine final site selection for *in situ* monitoring.

Task 5. Assess the Effects of Flow Regime on Dwarf Wedgemussel and Their Habitat

All six study requests expressed interest in an assessment of potential effects of flow regime (which includes water-level fluctuations) on DWM populations and on the availability of DWM habitat. Study requests cited a publication on the effects of flow and substrate parameters on DWM habitat persistence in the Delaware River (Maloney et al., 2012), suggesting that this could be a model for the Connecticut River studies. Several other studies might also help to guide study plan development and offer alternate analyses (Hardison and Layzer, 2001; Howard and

Cuffey, 2003; Morales et al., 2006; Gangloff and Feminella, 2007; Allen and Vaughn, 2010; Daraio et al., 2010). All of these studies involve physical habitat modeling with varying levels of complexity in terms of the habitat parameters that are measured or modeled, the types of analyses, and the degree to which field-collected, biological data are integrated into the model.

TransCanada proposes to use the distribution, density, habitat, and behavioral data collected during Tasks 1 through 4, in combination with the data collection and analysis for Studies 4 (Hydraulic Modeling), 5 (Operations Modeling), 7 (Aquatic Habitat Mapping), and 9 (Instream Flow Study) to assess the effects of flow regime on DWM and their habitat. Supporting information on DWM habitat preference will come from other studies conducted in the Connecticut River watershed (Nedeau, 2008, and references therein) and elsewhere in their range (e.g., Strayer, 1993; Strayer and Ralley, 1993; Maloney et al., 2012).

This assessment will benefit by first identifying where the largest DWM populations occur in the project area and how this overlaps with areas of greatest flow fluctuations (Tasks 1 and 2), gathering quantitative population and habitat data at these sites (Task 3), and observing mussels and their habitat over a range of flows (Task 4). The data collection and analysis for the other studies (4, 5, 7, and 9) may focus specifically on those areas where these mussel data are collected to allow better integration of both physical and biological data in the resulting models. Regardless of the analysis, TransCanada feels it is premature to plan this specific task until Phase 1 mussel studies are completed, and there has been an opportunity to consider potential biological limitations of the assessment (i.e., population size, spatial extent, habitat use). Once Phase 1 studies are complete, TransCanada will develop a study plan in consultation with the aquatics working group and file it with FERC for approval.

ANALYSIS

Task 1 will follow the same level of analysis and mapping used to develop the 2011 report. Task 2 will rely on descriptive statistics, written summaries, maps, photographs, and clearly presented data to convey how sites were assessed and why certain sites were selected for more detailed studies. Analyses are not yet defined for Tasks 3 through 5.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

Overall, a two-phase approach is a widely accepted, highly recommended practice to refine key study considerations and provide preliminary data (i.e., Phase 1) to help plan more detailed studies (i.e., Phase 2). This approach will ensure that resource agency goals and objectives are adequately addressed, time is used efficiently, and studies serve their intended purpose. As recommended by resource agencies, methods for Task 1 match those used for the 2011 survey. Task 2 methods are widely accepted for evaluating populations and habitats and for informing the development of suitable study designs and methods. Aside from the pilot study for Task 4, methods and analyses are not yet defined for Tasks 3 through 5. TransCanada feels that the best path forward is a collaborative approach with the aquatics working group with an awareness of the relevant publications and case studies to guide development of study plans.

DELIVERABLES

Task 1 results will be integrated into the 2012 mussel survey report, and an updated version of that report will be provided to the aquatics working group. Results from Task 2 and the pilot study for Task 3 will be compiled into a separate confidential report. Key topics for the Task 2 report will include the following: 1) complete rationale for the initial screening process, 2) maps and a summary of mussel data and habitat data gathered at each of the sites, 3) summary of environmental and logistical constraints to accessing or surveying each site, and 4) recommendations for monitoring sites. The confidential report for the Task 3 pilot study will include a summary of methods, parameters measured, maps of locations where observations were made, a summary of observations, underwater photographs, and underwater video (on DVD). Additional deliverables will depend on the outcomes of the Phase 1 studies and consultation with the aquatics working group on Phase 2 studies.

The complete updated mussel survey report and Task 2 and pilot study reports will contain sensitive information that would be inappropriate for distribution to the general public. Participants in the aquatics working group will have full access to both reports. Consequently, all persons participating in the aquatics working group will be asked to sign a confidentiality agreement. Redacted versions of both reports will be developed for distribution to the general public, with sensitive information eliminated. In all cases, draft reports will be prepared for stakeholder review and comment. Stakeholder comments (redacted as needed) on draft reports will be included in the final reports with an explanation of any stakeholder comments not incorporated.

Results and non-confidential conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application. A stand-alone confidential report will be provided to FERC, FWS, New Hampshire NHB, and Vermont NHIP, in which specific locations and details of individual populations will be provided.

SCHEDULE

Task 1, Task 2, and the pilot study for Task 3 will be completed in the 2013 field season, any time from June to September. Ideally, fieldwork would be completed early in that potential time frame, results will be summarized and provided to the aquatics working group, and a plan and timeline for Phase 2 studies can be developed.

LEVEL OF EFFORT AND COST

Phase 1

The preliminary estimated cost for Phase 1 is $30,000, and Phase 2 could range from $50,000 to $100,000, depending upon working group consultation.

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REVISED STUDY 25

DRAGONFLY AND DAMSELFLY INVENTORY AND ASSESSMENT

RELEVANT STUDY REQUESTS

VANR-29

STUDY GOALS AND OBJECTIVES

In its study request, VANR requested a baseline inventory of odonates (dragonflies and damselflies) and collection/synthesis of key life history, ecology, and habitat data to help assess the effects of current project operations on habitat and survival in the Wilder, Bellows Falls, and Vernon Project-affected areas. The study request emphasized SGCN but generally outlined objectives, methods, and analyses that would effectively target all odonate species that use riverine habitat for larval stages.

This study plan has two related goals: 1) inventory the river-dependent odonate assemblages in the project-affected areas, including life history, ecology, and behavior information for each species; and 2) assess the potential influence of project operations on river-dependent odonate larval emergence/eclosion and habitat. The four specific objectives are to:

1. conduct a baseline inventory and habitat assessment that builds on prior surveys in the project areas;
2. collect field data on the emergence and eclosion behavior of river-dependent odonates in the project areas;
3. review and synthesize available information on the life history, ecology, and behavior of river-dependent odonates that occur in the project areas; and
4. use information gathered in objectives 1–3, combined with data and analyses from other studies, to develop an overall assessment of the potential effects of project operations on odonate emergence/eclosion and habitat.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In its study requests, VANR described various jurisdictional resource management goals for this study, as summarized below.

VANR

- State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat.
- General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to

meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.

- VFWD general goals related to conserving, enhancing and restoring natural communities, habitats, species and the ecological processes that support them and providing fish and wildlife-based activities including viewing, harvesting and utilization of fish, plant and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005), including three odonate SGCN.

ASSOCIATION WITH OTHER STUDIES

At least five other studies have objectives and methods that complement this study and that will contribute to a greater understanding of the effects of project operations on aquatic resources in the study area. The results from the Aquatic Habitat Mapping Study (Study 7), the 2012 Rare Species and Communities Survey (Normandeau, 2013), and preliminary results from the Floodplain, Wetland, Riparian, and Littoral Vegetation Habitats Study (Study 27) will be used to help select sampling sites. The final results and analysis of this study will also incorporate findings from the Instream Flow Study (Study 9); Hydraulic Modeling Study (Study 4); and Riverbank Erosion Study (Study 3). Because odonates use aquatic habitats as larvae, riverbanks and riparian habitats for emergence/eclosion, and upland habitats as adults, studies within and across these habitats will help provide a more comprehensive assessment of odonate usage in the study area.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Thirty-three species were found in the most recent odonate survey in the Connecticut River in New Hampshire and Vermont (Hunt et al., 2010); seven of the species are SGCN in Vermont, and an eighth species was newly reported in Vermont and possibly rare. All eight of these species are riverine dragonflies in the family Gomphidae. These include:

- *Gomphus abbreviatus,*
- *Gomphus quadricolor,*
- *Gomphus vastus,*
- *Gomphus ventricosus,*
- *Ophiogomphus rupinsulensis,*
- *Stylurus amnicola,*

- *Stylurus scudderi,* and
- *Progomphus obscurus*.

Hunt et al. (2010) sampled 13 sites in the Connecticut River from Northumberland to Hinsdale, NH. Ten of these sites were in areas influenced by the Wilder, Bellows Falls, and Vernon Projects. Pfeiffer (2009) reported four Vermont SGCN species downstream from Vernon dam. These reports provide valuable baseline information on the odonate species that occur in the project-affected areas; however, site selection, species data, and habitat parameters collected at each survey site do not provide enough information to fully achieve study objectives.

The effects of water-level fluctuations stemming from project operations on the emergence and eclosion success of odonates are not well understood. Aquatic larvae crawl out of the water (i.e., “emerge”) when they are mature and ready to metamorphose into the adult phase of their lives. They crawl onto the riverbank, or onto emergent vegetation or woody debris, to find a suitable location to eclose, which is the process by which the adult sheds the larval exoskeleton before taking flight. For a short period after eclosion, the adult wings and exoskeleton are soft and the adults cannot yet fly, making them susceptible to fluctuating water levels and predators during this period. Species with a propensity to crawl farther up the streambank and gain a greater vertical distance from the water’s surface are at lesser risk from fluctuating water levels. One key information gap this study will address is how the magnitude and timing of project-related, water-level fluctuations may affect odonate species with different emergence and eclosure behaviors.

PROJECT NEXUS

Seven of Vermont’s SGCN odonates occur in the Connecticut River in the Wilder, Bellows Falls, and Vernon Projects, yet the distribution and habitat of these and other odonate species is not well understood. Project operations may influence odonate assemblages in these areas, primarily via effects on habitat use/suitability, or survival during emergence/eclosion due to water-level fluctuations. This study will document the distribution, relative abundance, habitat, and behavior of emerging and eclosing larvae of both SGCN odonates and the entire river-dependent odonate assemblage found in project areas. These data and other studies will be used to assess the potential effects of project operations, particularly water-level fluctuations.

STUDY AREA AND STUDY SITES

The study area includes the Wilder, Bellows Falls, and Vernon impoundments and the two riverine reaches downstream from Wilder dam and Bellows Falls dam, as well as approximately 1.5 miles below Vernon dam. Seven of the sampling sites from Hunt et al. (2010) that occur within these areas will be used as study sites to maintain continuity with that study. These include two in the Wilder impoundment, one downstream from Wilder dam, two in the Bellows Falls impoundment, and two in the Vernon impoundment. Four additional sites will be selected to provide wider geographic and habitat diversity. In general, the sites will be located to include one toward the middle of the Wilder impoundment, one additional site downstream of Wilder dam, one site downstream of Bellows Falls dam, and one site downstream of Vernon dam. Final site selection will be developed in consultation with the terrestrial working group and in consideration of results from the Aquatic Habitat Mapping (Study 7). Overall, this approach results in a total of 11 sampling sites: 4 in riverine reaches and 7 in the impoundments.

In general, study sites will be 100 meters in length, and will be selected primarily based on two considerations: 1) is habitat suitable for odonates, and 2) is habitat representative of conditions within that reach. Field reconnaissance and results of the Aquatic Habitat Mapping Study (Study 7) and the Floodplain, Wetland, Riparian, and Littoral Vegetation Habitats Study (Study 27) will help with site selection.

METHODS

Timing

Each site will be surveyed three times during the summer: mid-June, mid-July, and early August. These times generally cover the peak emergence periods of most odonates, particularly SGCN species. Surveys will be conducted when weather and flow conditions are conducive to collecting larvae and exuviae and when larvae are more likely to be emerging. Optimal sampling conditions include warm, sunny days when river discharge is near or below average, during low water cycles. TransCanada operations staff will be consulted to help coordinate field work with low water opportunities, to the extent feasible.

Field Data Collection

Odonate sampling methods will target mature larvae, pre-flight adults (called tenerals), and exuviae. The focus will be on those individuals that have emerged from the water, but there will also be an effort to collect pre-emergent mature larvae by sampling in near-shore shallow water. Basic methods will generally follow Morrison et al. (2006) and Hunt et al. (2010), but with a more quantitative approach. These methods are briefly described below:

- Five 3-meter wide transects will be randomly placed within each of the eleven 100-meter-long survey sites. The long axis of each transect will be perpendicular to the shoreline with the lower end at the estimated low waterline and the upper end terminating 1 meter into dense vegetation or at the top of the riverbank, whichever is less. The upper and lower ends of each transect will be recorded with GPS.

- Within each transect, biologists will thoroughly search for larvae, tenerals, and exuviae. Each individual that is found will be either identified in the field (if possible) or put into its own uniquely numbered vial. The following information will be recorded for each individual:
  - species;
  - time when collected;
  - surface from which it was collected; and

  - horizontal, vertical, and straight-line distance from the waterline.

- For each transect sampled on each date, the following habitat information will also be collected:

  - types and percent coverage of soil/substrate;
  - types and percent coverage of vegetation;
  - percent coverage of large woody debris or other types of cover;
  - the height, slope, and relative stability of the streambank;
  - evidence of recent versus current water levels; and
  - representative photos.

- In addition to the transect-specific data, biologists will also describe and photograph aquatic, riparian, and upland habitat along the entire length of the 100-meter sampling sites.

- At each site and on each sampling date, an aquatic D-net will be used to capture larval odonates from a representative range of microhabitats, and the first 50 larvae captured will be preserved in alcohol. During D-net sampling, the relative abundance of larval odonate prey species captured incidentally, such as larval insects, crustaceans, and aquatic worms will be recorded.

- If larvae are observed in the process of emerging, their position, time, and distance walked from the first point of observation to the end of that survey period will be recorded.

- All odonate specimens will be identified to species either in the field or laboratory, as needed.

Literature Review

Existing books, manuals, peer-reviewed journal articles, unpublished technical reports, and other case studies will be reviewed to compile key life history, ecology, and behavior data for each of the odonate species found in the project areas. Particular emphasis will be placed on SGCN odonates.

ANALYSIS

Field data will allow for a quantitative analysis of odonate density (number per meter per transect) and abundance (total count by sample site) at each sampling site, an analysis of the variability in density and abundance within and among sampling sites and sampling dates, and an analysis of the influence of measured habitat parameters on odonate density and abundance. In addition, field data will include key species-specific information such as emergence times, distances and heights that larvae travel before eclosion, and preferred substrates for emergence and eclosion. These field data will be supplemented with the literature review to provide a database of when, in what conditions, and where odonates emerge and eclose, as well as the susceptibility of each species to water-level fluctuations.

Results of the Aquatic Habitat Mapping Study (Study 7), Hydraulic Modeling Study (Study 4), Operations Modeling Study (Study 5), Instream Flow Study (Study 9), Riverbank Erosion Study (Study 3) and Floodplain, Wetland, Riparian, and Littoral Habitats Study (Study 27) will be used to assess the potential influence of project operations and water-level fluctuations on river-dependent odonates; the primary focus will be on SGCN species.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

Methods outlined for site selection, field data collection, and analysis are consistent with other studies that seek to understand the odonate assemblages in large rivers, habitat use, emergence and eclosion behavior, and potential effects of water-level fluctuations. VANR requested methods similar to Morrison et al. (2006), and this study plan uses these basic methods (minus the river bottom transects) but also uses methods that will allow for more quantitative analyses, which will be a more effective way of integrating results of the water-level fluctuation study, and expressing results in quantitative terms.

DELIVERABLES

A final study report will be prepared after the first year field season. The report will follow a standard scientific format but will be sensitive to the need for confidentiality for rare species. Confidential appendices will be provided to the Natural Heritage Bureaus of New Hampshire and Vermont, and will include appendices containing maps, raw field data, field notes, and species information. Voucher specimens will be retained and made available to resource agencies.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This study will occur in the first study year (2014). Potential sampling sites may be assessed in late 2013 for planning purposes. In 2014, field studies will occur from June to August, laboratory identification of specimens will occur throughout the summer and fall, and a draft report will be prepared in late fall.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this study is $101,000.

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REVISED STUDY 26

COBBLESTONE AND PURITAN TIGER BEETLE SURVEY

RELEVANT STUDY REQUESTS

VANR-30

STUDY GOALS AND OBJECTIVES

In its study request, VANR identified potential issues associated with Wilder, Bellows Falls, and Vernon Project operations on two species of tiger beetle listed as Vermont SGCN. One of these species, the Puritan tiger beetle (*Cicindela puritana*), is listed as threatened federally and in the State of Vermont. It is also listed as endangered in the State of New Hampshire. The cobblestone tiger beetle (*Cicindela marginipennis*) is listed as threatened in both New Hampshire and Vermont. Specifically, potential habitat disturbance, alteration, and loss as well as sedimentation due to project operations could negatively affect these species.

The goal of this study is to conduct a survey to detect and gather information on known and new cobblestone tiger beetle and Puritan tiger beetle populations along the Connecticut River throughout the project-affected areas, including the impoundments and downstream on the riverine reaches, and to determine the potential effects of project operations on tiger beetles.

The objectives of this study are to:

- obtain baseline distributional and abundance data and map occurrences of cobblestone and Puritan tiger beetle populations along the Connecticut River throughout the three project-affected areas;

- define the particular habitat requirements of each species;

- assess the vulnerability of each species to disturbances such as siltation, flow fluctuations, and changes in shoreline composition and vegetation;

- identify areas where suitable habitat may exist for these tiger beetle species and the portions of those habitats affected by project operations; and

- determine if project operations are adversely affecting the survival success of adult and larval cobblestone and Puritan tiger beetles.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In its study request, VANR described various jurisdictional resource management goals for this study, as summarized below.

VANR

- Cobblestone tiger beetle is a state-listed threatened species. Specific goals for rare, threatened, and endangered species include maintaining or increasing populations; and maintaining, restoring, providing stewardship for, and conserving habitats and natural communities that support rare, threatened, and endangered species.
- State water quality standards for designated uses of Class B waters relative to levels of water quality that fully support aquatic biota and habitat.
- VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them; and providing fish- and wildlife-based activities, including viewing, harvesting, and utilization of fish, plant, and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005), including two beetle SGCN.

ASSOCIATION WITH OTHER STUDIES

Preliminary results from the Aquatic Habitat Mapping (Study 7) and the Floodplain, Wetland, Riparian, and Littoral Vegetation Habitats (Study 27) will be used to assist in locating potential tiger beetle habitat and sampling site selection. The final results and analysis from this study will also incorporate findings from the Instream Flow Study (Study 9); Channel Morphology and Benthic Habitat Study (Study 8); Hydraulic Modeling Study (Study 4); Riverbank Erosion Study (Study 3); and Operations Modeling Study (Study 5). Habitat identification, field work, and analysis for this study may be conducted in conjunction with the Dragonfly and Damselfly Inventory and Assessment (Study 25), Fowler's Toad Survey (Study 28), or with other surveys conducted during the same timeframe.

EXISTING INFORMATION

The Puritan tiger beetle is listed as a threatened species federally and by Vermont, and as an endangered species in New Hampshire. It is only known historically in the project-affected areas from several New Hampshire sites and a single Vermont site in Hartland, VT, within the Bellows Falls Project. The historical distribution of Puritan tiger beetles included locations in the Connecticut River that extended from Claremont, NH, to Cromwell, CT. Nine of these populations were extirpated in the early 1900s, with the latest collection records in the 1930s (Knisley, 1987, cited in Hill and Knisley, 1993).

The distribution of Puritan tiger beetle, both historical and current, is restricted to two disjunct regions, Chesapeake Bay in Maryland and the Connecticut River in New England. Vogler et al. (1993) performed a genetic analysis of individuals from the two regions and concluded that the occurrences on the Connecticut River "have to be considered as independent units." Historically, there are records of Puritan tiger beetles from New Hampshire and Vermont but despite intense searching by tiger beetle experts over the last 25 years, no occurrences have been found upstream of Hadley, MA.

Impoundments along the Connecticut River are believed to have contributed to the extirpation of this species. Riverside recreational use has had a significant effect on populations at other New England sites, although in some cases recreational activity provides surrogate disturbance that delays vegetative succession. Historically found along the Connecticut River in Hartland, VT, and nearby New Hampshire sites, larval density of this species is highest along big rivers in sparsely vegetated patches of fine to medium sand (particles predominantly 0.125 to 0.5 mm [Omland, 2002]); in some instances, suitable habitat may be embedded in wide beaches (e.g., Northampton, MA) but in other instances, the beach may be quite narrow (e.g., 4 to 6 meters in Cromwell, CT). Given their genetic distinctness, the species' association with clay banks in Maryland may not be relevant to habitat preferences in New England.

The cobblestone tiger beetle is listed as threatened in both Vermont and New Hampshire. It has been studied in Vermont to a greater degree than other *Cicindela* species. According to VANR in its study request, habitat losses along the Connecticut River and possibly along other rivers have been significant due to impoundments. The cobblestone tiger beetle is found in the vicinity of the projects on the Connecticut River including one at least one island, the West River, and the White River. This species has an extremely restricted habitat and is found on cobble and gravel beaches on medium and large rivers. Adults inhabit areas of cobble, gravel, and sand where vegetation is sparse. Larvae are thought to occupy burrows in the sand along the edges of or interspersed with cobblestones.

PROJECT NEXUS

Project operations and land uses have the potential to cause direct adverse effects on tiger beetle populations through effects on the egg, larval, and pupal stages; direct effects on adult beetles are unlikely. Threats to larval habitat are primarily due to vegetative succession mediated by diminished erosion dynamics. Inundation per se is unlikely to affect buried life stages because tiger beetles have adapted to tolerate frequent and/or prolonged submersion (Brust and Hoback, 2009), and it is likely that larvae dwell higher than the daily inundation zone on riverbanks (Omland, 2002). However, if the daily inundation cycle or recreational activity on the riverbanks causes larval burrows to collapse frequently, then there may be an energetic cost of re-excavating burrows, which would divert resources from growth and reproduction. Knowing whether larvae of the two focal species are present in the project-affected areas and how they may be affected by vegetative succession, inundation, or recreational activity will enable an assessment of whether project operations are having adverse effects on the populations.

STUDY AREA AND STUDY SITES

The study area encompasses the Wilder, Bellows Falls, and Vernon impoundments and riverine reaches below Wilder and Bellows Falls dams that are identified to be historic or potentially suitable habitat for tiger beetles, including Hart's, Johnson, Burnaps, Chase, and Walpole Islands and an area with slowly moving water at the mouth of Mascoma River. Vernon dam discharges into a reach that has limited riverine habitat due to impoundment fluctuations associated with a combined operational effect from the Turners Falls Project (FERC No. 1889) and Northfield Mountain Pumped Storage Project (FERC No. 2485). While no known habitat for the listed tiger beetles is known to occur in this section, TransCanada will also review the shorelines of the river and Stebbins Island for approximately 1.5 miles below Vernon dam for potential tiger beetle habitat. Having identified likely habitat patches from historical records and inspection of orthophotos, only specific patches will be included in this study.

Cobblestone tiger beetles and Puritan tiger beetles occupy distinct habitats along the Connecticut River as larvae and adults. Larval habitat is more specific than adult habitat. Puritan tiger beetle larvae are found at highest density in fine to medium sand, which is associated with slow-moving water. Adults may be found foraging near larval habitat on a variety of substrates ranging from mud to coarse sand. Puritan tiger beetles inhabit fine-to-medium sand beaches along bends of big rivers. For instance, the beach in Massachusetts where they have been found is dry, wide, free of vegetation, and located on a bend of the river (MA NHESP, 2010), while the beaches in Connecticut where they have been found are wet, narrow, and sparsely vegetated and located on a straight reach. Larvae live in burrows along the upper margin of the beaches.

In contrast, cobblestone tiger beetles are associated with cobble and gravel bars and beaches that have a mixture of coarse sand. Larval biology of cobblestone tiger beetles is poorly known but it is presumed they dig burrows in sand in such places. Cobblestone tiger beetles are found on the edges and islands of small to medium sized rivers with swiftly flowing water. They are restricted to scour areas along these rivers where the substrate is composed of wet pebbles, cobblestone, sand, and sparse vegetation. The larvae dig burrows in wet sand found interspersed among cobblestones (Pearson et al., 2006).

METHODS

Aerial photography and data from preliminary aquatic and terrestrial habitat mapping (Studies 7 and 27) will be examined for patches of potentially suitable habitats for cobblestone and Puritan tiger beetles based on lack of vegetation and substrate composition. Areas of apparently suitable habitat will be visited by boat or on foot during low water cycles (to the extent possible and in consultation with TransCanada operations staff) to confirm habitat suitability. Areas with high quality habitat seen during sampling site selection will also be examined. In addition, historical areas where cobblestone and Puritan tiger beetles were found will be examined for larval burrows and adult specimens. Areas where these tiger beetle species were found during previous studies (Dunn, 1978; Dunn, 1986; Omland,

2004) will be searched in each project. Coordinates of previous records will be requested from the Vermont and New Hampshire natural heritage programs. Three separate searches (Hudgins, 2012) will be conducted during the adult flight period in mid-June, mid-July, and early August.

Prior to conducting the field surveys, endangered species collection permits will be obtained from the Vermont DFW and the New Hampshire DFG for the cobblestone tiger beetle. FWS and VDFW will also be contacted for a permit to search for Puritan tiger beetle, if necessary. Searches will be conducted by walking along each beach or cobble bar from access point to end in a serpentine pattern until the area has been completely searched (Hudgins et al., 2011). Searches will be conducted under sunny, humid conditions during low water cycles when adult tiger beetles are most active. Searchers will primarily look for adults; however, because it may be possible for adults and larvae of tiger beetle species to overlap, locations of larval burrows observed during the adult surveys will be flagged.

Two biologists equipped with close-focus binoculars and aerial nets will search each survey location for a minimum of 30 minutes. Survey time will be recorded to calculate an index of relative abundance for each species. At most sites, representative photographs of adult tiger beetles will be taken to document identification. Occasional individuals of the listed species may be netted to confirm and document identification. In addition to the two target species, the common shore tiger beetle (*Cicindela repanda*) and other tiger beetles may also occur on the beaches. If observed, counts of common species will be estimated. Clasping pairs or individuals probing the sand with the tip of the abdomen will be noted as possible evidence of reproduction. If Puritan tiger beetles are observed during the survey, FWS will be notified immediately. These individuals will not be disturbed but may be photographed.

Following the active search for adult beetles the biologists will search the survey location for larval burrows for 30 minutes. Tiger beetle larval burrows may be recognized as neat, nearly perfectly round holes often with a distinct pile of excavated soil pellets nearby (burrows of wasps, spiders, and other arthropods are not like that). Grass stems will be used to probe any larval tiger beetle burrows found. Depth of burrows will be recorded, and angle relative to vertical will be noted. Larval burrows of the common shore tiger beetle are expected to be numerous and are recognized in the field as being 5 to 10 cm deep and angled. In contrast, burrows of Puritan tiger beetle larvae are vertical and deep (50 to 100 cm). Larval biology of cobblestone tiger beetles is poorly known but it is likely that they are different than those of the common shore tiger beetle either in being deeper or vertical. If a distinct class of tiger beetle burrows is found at a site where adult cobblestone tiger beetles are known, their locations relative to the water level during the survey will be recorded; if at least 10 such burrows are found, then one larva will be excavated, preserved in alcohol, and sent to a taxonomic expert for identification. However, if the burrows are similar to those described for Puritan tiger beetles in Connecticut (50 to 100 cm deep, vertical; Omland, 2002), then FWS personnel will be notified of the possible presence of the listed species, and no specimens will be collected.

Substrate, vegetative cover, land use and other pertinent habitat information will be recorded on field data sheets. Field staff will use professional judgment to take 3 to 5 representative samples for particle size classification screening sand through sieves and estimating the b-axis of gravel or cobble particles typical of the site. Apparent suitable habitat will be delimited using a GPS capable of submeter accuracy. The elevation relative to operational flows will be estimated by field survey of the center of the site relative to water levels. By noting the time of survey and comparing that time to river discharge records, the approximate elevation of the water can be estimated.

Field data will be supplemented with a literature review to provide a comprehensive database on when and under what conditions the listed tiger beetles are vulnerable to water-level fluctuations.

ANALYSIS

Data collected will be used to qualitatively assess the distribution of cobblestone and Puritan tiger beetles in the study area. Survey results will include presence, relative abundance, evidence of reproduction, and information on habitat used for these species, including potential habitat. Incidental observations of other beetles will also be summarized. The location of survey areas will be identified on a map of each project as well as a description of habitat conditions at each location. A list of all adult tiger beetles identified from each survey location and their relative abundance for each location and sample trip will be developed.

Project operations schedules; results from the Aquatic Habitat Mapping (Study 7); Floodplain, Wetland, Riparian, and Littoral Vegetation Habitats Study (Study 27); Instream Flow Study (Study 9); Channel Morphology and Benthic Habitat Study (Study 8); Hydraulic Modeling Study (Study 4); Riverbank Erosion Study (Study 3); Operations Modeling Study (Study 5); and river discharge data will be compared to determine river discharge levels that may affect cobblestone and Puritan tiger beetle populations. The portion of the habitat that is affected by project operations will be determined to develop an estimated frequency of inundation of each survey location.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

Larval sampling will follow one of several methods described by Leonard and Bell (1999) including the recommended procedures of Brust et al. (2010). Adult sampling will use a standard timed search by two biologists searching with close-focus binoculars and aided by aerial nets. Survey distance and time will be recorded to provide an index of relative abundance.

DELIVERABLES

A study report will be prepared that presents methods and results of the survey after this 1-year study. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

The tiger beetle survey will be conducted during the first study year (2014) in July and August to coincide with adult emergence of both focal species. Identification of adults will occur in the field. Some larvae may be collected to be sent to taxonomic experts with determination expected in the fall of 2014 or winter of 2015. The study report will be prepared after the field season.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this study is $48,000.

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REVISED STUDY 27

FLOODPLAIN, WETLAND, RIPARIAN, AND LITTORAL VEGETATION HABITATS STUDY

RELEVANT STUDY REQUESTS

FWS-19; NHDES-15a; NHFG-15; NHNHB-01; VANR-25, -26; CRWC-16; TNC-03; Rock-02, -03

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHFG, NHNHB, VANR, CRWC, TNC, and the Town of Rockingham, Vermont, indicated that Wilder, Bellows Falls, and Vernon Project operations may affect the distribution, plant species composition, and structure of riparian, floodplain, wetland, and littoral habitats, and the wildlife that utilize these areas. The goal of this study is to provide baseline mapping and characterization of riparian, floodplain, wetland, and littoral vegetation and habitats within the Wilder, Bellows Falls, and Vernon Project-affected areas and to assess the potential effects of water-level fluctuations on those habitats.

The objectives of this study are to:

- quantitatively describe (e.g., substrate composition, vegetation type, and abundance with a focus on invasive species) and map riparian, floodplain, and wetland habitats within 200 feet of the river's edge and the extent of this habitat if it extends beyond 200 feet;

- quantitatively describe (e.g., substrate composition, vegetation type, and abundance) and map shallow-water aquatic habitat types within the zone of daily water-level fluctuations and where water depths at the lowest operational range are wetted to a depth of less than 1 foot (flats, nearshore area, gravel bars, with very slight bathymetric change);

- qualitatively describe associated wildlife (e.g., bald eagle nesting, waterfowl nesting); and

- assess potential effects of project operations on riparian, floodplain, wetland, and littoral vegetation habitats, and associated wildlife.

RELEVANT RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS	• General goals for relicensing including ensuring that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives; and conserving, protecting, and enhancing habitats

for fish, wildlife, and plants affected by the projects.

	• General goals related to aquatic resources including protection, enhancement, or restoration of aquatic and riparian habitats and minimizing project effects on water quality and aquatic habitat.
NHDES	• State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	• General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference the New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).
NHNHB	• Goals of the NHNHB include developing information about indigenous plants and natural communities and determining protective measures and requirements necessary to their survival. Goals reference New Hampshire's Native Plant Protection Act (RSA 217:A).
	• Goals of the NHDES Wetlands Bureau include protecting and preserving submerged lands and wetlands from unregulated alteration that would adversely affect wetlands structure and function, and that would depreciate or obstruct the commerce, recreation, and aesthetic enjoyment of the public. Goals reference New Hampshire Fill and Dredge in Wetlands statute (RSA 482-A).
VANR	• State water quality standards for designated uses of Class B waters relative to levels of water quality that fully support aquatic biota and habitat.
	• Specific goal to identify and protect significant wetlands and their values and functions.
	• General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.
	• VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them; and providing fish- and wildlife-based activities including viewing, harvesting, and

utilization of fish, plant, and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005).

- VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety. Goals reference the Vermont Fish and Wildlife Strategic Plan (VFWD, 2006).

ASSOCIATION WITH OTHER STUDIES

This study will rely on several other studies for supplemental information. The Aquatic Habitat Mapping Study (Study 7) in the project impoundments and riverine sections will provide bathymetric and littoral habitat delineation for aquatic vegetation beds below 2 feet water depth. The results of Hydraulic Modeling and Operations Modeling studies (Studies 4 and 5) will provide site-specific detailed data on water-level fluctuations and river flows. The riverbank erosion studies (Studies 1, 2, and 3) will inform the vegetation community and wildlife findings.

Goals associated with mapping vegetative types and wildlife species composition will be supported by specific studies, including: the Northeastern Bulrush Survey (Study 29); Cobblestone and Puritan Tiger Beetle Survey (Study 26); Dragonfly and Damselfly Inventory and Assessment (Study 25); and Fowler's Toad Survey (Study 28).

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Existing habitat information in the PADs is based primarily on state or regional mapping efforts including the USGS land use cover maps (Homer, 2007), the Wildlife Action Plans for New Hampshire and Vermont, National Wetland Inventory mapping, and limited local data on floodplains and wetlands. Several towns in New Hampshire and Vermont have completed natural resource inventories, including Lebanon and Charlestown, among others. To the extent that these inventories are available, they will be reviewed for additional data on habitats, plant communities, and wildlife records.

Results from the 2012 TransCanada study of rare, threatened, and endangered plants and listed natural communities (Normandeau, 2013) will be used in combination with existing records and locations of rare plant species and communities from VANR and NHNHB. General descriptions of those habitats and communities are available in Sperduto and Kimball (2011) and Thompson and Sorenson (2000). Other relevant studies that have been recently completed, are ongoing, or sponsored by TransCanada include a 2010 shoreline survey (Kleinschmidt, 2011), eagle nesting studies conducted by New Hampshire Audubon, and mussel surveys (Biodrawversity and LBG, 2012). The results and findings of these studies will inform the study of riparian, floodplains, wetland, and littoral habitats. To date, no detailed existing data set for wildlife or wildlife habitat has been identified in the project areas.

This study will provide more detailed mapping and characterization of riparian, floodplain, wetland, and littoral habitats, and will supplement knowledge of wildlife habitat and use in the study area. The potential effects of project operations on those habitats and wildlife will be assessed using data from other studies of hydrology, erosion, and aquatic habitats.

Data for reference wetlands will not be collected, as proposed in an agency study request. On a large system such as the Connecticut River it is unrealistic for several reasons: few if any reaches of the river are not affected by water management; the river changes character rapidly north and south of the project areas; and lastly, the natural variability of any potential reference habitats would require a very large data set for effective comparisons to project habitats, of limited value and at significant expense.

PROJECT NEXUS

The Connecticut River provides habitat for vegetation communities ranging from upland to submerged aquatic systems. Groundwater and surface water close to the river are potentially influenced by daily and seasonal project operations, which in turn may affect the substrates, species composition, and structure of the vegetation communities bordering the river, particularly those in lower topographic settings such as wetlands and floodplains. Intact, natural riparian habitat is valuable wildlife habitat providing water quality, bank stabilization, and wildlife travel corridors.

A more detailed understanding of the distribution and character of the existing habitats will allow an analysis of the potential effects of project operations on those habitats. Coincidental wildlife observations will better inform the analysis of wildlife species that rely on the river for part of their life cycle.

STUDY AREA AND STUDY SITES

The study area will extend from the top of Wilder impoundment to Vernon dam including the Wilder, Bellows Falls, and Vernon impoundments and the riverine sections downstream of Wilder and Bellows Falls dams, and extending approximately 1.5 miles below Vernon dam. All of the shorelines in Vermont and New Hampshire, including the river's edge, islands, sand and gravel bars, and impounded portions of the tributaries, will be mapped. The terrestrial extent of the study will encompass 200 feet from the river's edge at a minimum. Where wetlands and floodplains extend farther inland than 200 feet, the study will encompass either the entire wetland or floodplain, or to where the topography or site features indicate the river is no longer a significant influence on the habitat.

This study scope accommodates most study requests, which asked for riparian and wetland studies within 200 feet of the river or the extent of this habitat if it extends beyond 200 feet. The TNC study request asked for surveys to extend to the 100-year floodplain, which in some areas could result in extensive mapping of terrestrial habitats far from the river. This will not contribute significantly to the information needed to assess the areas influenced by project activities, and hence is not included in this study plan. The littoral zone will extend from the river's edge to a depth of 1 foot below the lowest limit of water-level fluctuation along the shorelines, islands, sand and gravel bars, and the impounded tributaries.

METHODS

Methods will include habitat mapping and field verification of riparian, floodplain, wetland, and littoral habitats, and observations for river-dependent wildlife. The methods will follow commonly accepted protocols, and will meet the components of the study requests, except where noted. For this study, the following definitions will apply:

- Riparian – all areas within 200 feet of the shoreline that are not classified as floodplain, wetland, or littoral. While 50 feet or 100 feet is more commonly used in a classic definition of riparian buffer (Williams, 2008; VANR, 2005), expanding the area to 200 feet, as requested by agencies, will allow a complete mapping of all land cover types within the study area.

- Floodplain – Floodplains are ecologically defined as occurring in the regularly flooded lowlands of major rivers or lakes. This study will include the typical forested floodplains associated with large, high-gradient rivers like the Connecticut, dominated by silver maple or sugar maple with a sparse shrub layer and a lush herbaceous layer of either ostrich fern or sensitive fern depending on the gradient of the river (NHFG, 2005; Kart et al., 2005). Floodplains that have been converted to other uses, such as agriculture, development, or recreation, or that have been affected by riverine erosion processes will be mapped as well.

- Wetland – All palustrine and riverine wetlands as defined by FWS (Cowardin et al., 1979). Palustrine wetlands include all non-tidal freshwater wetlands dominated by trees, shrubs, persistent emergent vegetation, emergent mosses, or lichens. Riverine wetlands include all wetlands and deepwater habitats within the river channel dominated by non-persistent emergent and aquatic vegetation. For the purposes of this study, the impoundments will be considered Riverine habitats.

- Littoral zone - For this study, the littoral zone will include all habitats within 1 foot below the lower limit of the water-level fluctuation zone, and all submerged aquatic vegetation (SAV).

Habitat Mapping

Aerial maps of the study area will be obtained in LiDAR, and true-color orthophoto format, and flown during leaf off, snow- and ice-free conditions. Stereo color photos may be available to resolve areas that are difficult to interpret. The LiDAR imagery will be collected at a data density sufficient to develop topography at 1-foot contour intervals in the study area.

The imagery will be used to digitally photo-interpret vegetation community cover types within the riparian, floodplain, wetland, and littoral habitats in the study area as described above. The minimum map unit size will be 0.5 acre. Additional publicly available maps of the study area will be used in conjunction with the aerial imagery to increase confidence in the cover type mapping, including USGS topographic maps, NRCS soils maps, National Wetland Inventory maps, and recent leaf-on orthophotos. Each wetland resource area will be cover typed by the dominant cover class, using the FWS Wetland Classification system (Cowardin et al., 1979), where appropriate. The three-tier Vermont wetland classification system specified under the Vermont Wetland Rules will be applied on wetland cover types mapped in that state. The remainder of the terrestrial cover types will be classified according to a combination of land use, vegetation, substrate and hydrology. Ponds, streams, and potential vernal pools will be identified within the various cover types.

A baseline mapping assessment of potential bald eagle winter roosting sites along the river will be conducted using aerial photography to identify potentially suitable winter roosting habitat. Desirable site features will include stands of mature white pine (*Pinus strobus*) adjacent to the river with a protected, south-facing aspect. Proximity to human disturbance and development will be a factor in estimating the suitability of the stands.

Accurately mapping SAV is difficult using either of the remote methods because SAV is virtually undetectable on LiDAR and during the leaf-off aerial photography season. SAV and unvegetated substrates will be mapped using a combination of the results from the Aquatic Habitat Mapping Study (Study 7) and field verification.

Polygons of the various cover types will be compiled in GIS for mapping and analysis.

Field Verification

A subset of the cover type maps will be field verified during the height of the growing season to confirm the approximate locations of the mapped boundaries and cover typing using GPS capable of submeter accuracy. Representative sites for the various cover types will be selected to encompass the geographic and hydrologic variability of each cover type. For access reasons, most of the representative areas will be confined to suitable sites within TransCanada fee-owned lands and publicly accessible lands. Outstanding or unique habitats within the study area on flowage easement lands may be visited, provided landowner permission for access is granted. Further field verification of cover type boundaries and other mapped features will occur where they are accessible or visible from the river or a public road.

The selected representative cover types will be visited to characterize the following habitat components: vegetation structure; species composition and abundance by structural layer, with a focus on invasive and rare species; soil type; hydrology; and other relevant aspects, including evidence of recent or historic disturbance, flooding or scour, and wildlife usage. GPS coordinates will be collected at distinct wildlife features such as bank nests, concentration of species or evidence of browse, large stands of invasive species, and other important site features. Photodocumentation will occur at each representative cover type.

Wetlands

Wetland functions and values will be assessed at all field-verified wetland cover types using the New England Division USACE Highway Methodology (USACE, 1995). This method is a descriptive, non-quantitative method that can be used to determine the degree to which a wetland provides a set of 13 functions and values: groundwater recharge/discharge; flood flow alteration; fish and shellfish habitat; sediment/toxicant/pathogen retention; nutrient removal/transformation; production export; sediment/shoreline stabilization; wildlife habitat; recreation; education/scientific value; uniqueness/heritage; visual quality and aesthetics; and threatened or endangered species habitat. The rationale for evaluating the performance of each function is developed from a series of criteria, and is supplemented by professional judgment. From this evaluation, the principal (most important) functions are identified. While this method is less rigorous than the methods proposed by the NHNHB and TNC, it allows a more rapid assessment of wetland functions and values while documenting the rationale and maintaining consistency between sites and users. Given the combined approximate 120-mile river length of the three projects, the USACE highway methodology assessment method provides a reasonable balance between efficiency and effectiveness. It will be conducted by a qualified wetland scientist to maintain quality and consistency.

Representative examples of vernal pools mapped from the orthophotos or otherwise encountered within the study areas will be visited to assess their likelihood of providing vernal pool habitat based on the definitions provided by the States of New Hampshire and Vermont. The focus will be on TransCanada fee-owned lands and public lands, but high quality examples of vernal pools with potential to be affected by the projects that occur on flowage easement lands may be visited with landowner permission. Because ground truthing will continue outside of the typical April-May window for identifying vernal pool amphibians, the potential for a pool or depression field checked later in the season to support vernal pool species will be inferred from habitat conditions.

Wetland boundaries will not be delineated on the ground using the USACE 1987 delineation manual, as requested by VANR because: 1) jurisdictional boundaries are not necessary to verify cover types for baseline mapping, or for the effective evaluation of potential project effects; 2) much of the land is in private ownership, not TransCanada fee-owned land; and 3) the cost of a jurisdictional delineation would be excessive relative to the minor additional information it would provide.

Rare Plants and Communities

The New Hampshire and Vermont Natural Heritage Databases will be revisited to identify rare species and communities that occur within the mapping area for this study. Many of the known “element occurrences” (EOs) were identified during the rare species identification and mapping effort conducted by TransCanada in 2012 (Normandeau, 2013). Locations of species and communities that were not visited in 2012 will be identified in GIS, and a subset of recent (post-1990) EOs may be visited to assess their current status; however, detailed inventories of these species and habitats are not included in this study.

Invasive Plant Species

Non-native invasive plant species will be defined using the Invasive Plant Atlas of New England (IPANE, 2012) which works with the States of New Hampshire and Vermont, TNC, and Silvio O. Conte National Wildlife Refuge to maintain a current list of invasive species within the study area. Known locations specified on the existing map of invasive species developed by TransCanada in 2010 (Kleinschmidt, 2011) will be revisited and refined. Well-defined beds of invasive species will be delimited with GPS or mapped on orthophotos. More diffuse or irregular boundaries will be estimated by a combination of GPS and field sketching. The mapping results will be added into the GIS dataset. Data collected in the field will include species, substrates, estimates of density, approximate elevation, and evidence of disturbance.

Wildlife Observations

All observations of wildlife and their sign will be noted during field verification, both at the representative cover type locations and during travel between sites. Species, approximate counts, activity, habitat, and apparent level of use will be recorded, and locations will be documented with GPS. Particular emphasis will be placed on river-dependent species, including bald eagle, waterfowl, wading birds, shorebirds, bank nesting birds (e.g., kingfisher, bank swallow), breeding amphibians, basking reptiles, nesting turtles, and mammals (river otter, beaver, muskrat). All other wildlife sign and observations will be recorded as encountered. Coordination with TransCanada, VFWD, NHFGD, and other organizations with local knowledge will provide additional search areas and likely habitats. Observations will consider the best times of day for capturing specific species (evening for chorusing frogs, early morning for breeding birds) to maximize the chance of encountering desired species.

ANALYSIS

The results of the cover type mapping will be compiled into site maps and summaries of the acreages of the various cover types within each project and project-affected area. Descriptions of the representative cover types will be developed, and the relative functions and values of each discussed. Unique conditions or findings will be highlighted, including invasive species concentrations, rare species, and disturbance. The presence and quality of vegetative buffers along the shoreline will be evaluated for water quality, riverbank stability and wildlife movement functions. Lands leased by TransCanada for agriculture require 100-foot buffers to the Connecticut River. In these locations the presence/absence of buffers will also be noted.

Per the FWS request during consultation meetings, TransCanada will use the data provided from the ongoing, multi-year bald eagle breeding survey conducted by New Hampshire Audubon and sponsored by TransCanada to characterize the known nest trees in the project areas. Data will include location and condition of the nest trees and the conservation or protected status of the land parcels within 250 yards of the nest tree. Potential bald eagle winter roosting sites along the river will be provided as mapped features.

Notable differences of habitats among the projects will be analyzed and if appropriate, compared to the results of the rare species studies (Studies 25, 26, 28, 29, and Normandeau [2013]), hydrologic studies (Studies 4 and 5), and erosion studies (Studies 2 and 3). The potential effects of project operations on the mapped riparian, floodplain, riparian, and littoral habitats, and wildlife usage areas will be assessed using the results of hydraulic and operations modeling (Studies 4 and 5).

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methodologies for mapping, delineation, field verification, and analysis presented above are consistent with accepted scientific practice and have been used at other hydroelectric projects in the Northeast, most recently at the Brassua Hydroelectric Project (FERC No. 2615).

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application. Sensitive rare species information will be provided to the appropriate agencies in a separate, confidential report.

SCHEDULE

The aerial imagery and LiDAR data were collected in the spring of 2013. Delineation and mapping will be conducted in early 2014. The resulting cover type maps will be field-verified in the 2014 growing season. The final reports will be produced at the end of 2014, after completion of analysis for this study and other relevant studies (Studies 2, 3, 4, 5, 25, 26, 28, and 29).

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this study is $211,000, excluding the costs for LiDAR and/or aerial photos.

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REVISED STUDY 28

FOWLER'S TOAD SURVEY

RELEVANT STUDY REQUESTS

VANR-31

STUDY GOALS AND OBJECTIVES

In its study request, VANR identified potential issues associated with operations of the Wilder, Bellows Falls, and Vernon Projects on Fowler's toad (*Anaxyrus fowleri*), mapped in Vermont's Wildlife Action Plan (Kart et al., 2005) as a high priority SGCN and listed as an S1, Very Rare species. This species is under consideration to be listed as endangered by the State of Vermont in 2014. The goal of this study is to conduct a survey to obtain baseline distributional and abundance data on Fowler's toad along the Connecticut River in the Bellows Falls and Vernon Project-affected areas.

The objectives of this study are to:

- develop additional information regarding the distribution and relative abundance of Fowler's toad;
- develop additional information regarding the distribution and condition of suitable Fowler's toad habitat within the study area; and
- assess whether project operations are likely to have an effect on suitable Fowler's toad habitat, and if those effects are likely to be positive or negative.

RESOURCE MANAGEMENT GOALS

In its study request, VANR described various jurisdictional resource management goals for this study, as summarized below.

VANR	• Fowler's toad is a state SGCN. State water quality standards for designated uses of Class B waters relative to levels of water quality that fully support aquatic biota and habitat. • General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat. • VFWD general goals for conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them; and providing fish- and wildlife-

based activities including viewing, harvesting, and utilization of fish, plant, and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005), including SGCN.

ASSOCIATION WITH OTHER STUDIES

Surveys for the distribution and abundance of Fowler's toads will be conducted in concert with other biological surveys for the relicensing effort, whenever feasible. The assessment of Fowler's toad habitat distribution and condition within project-affected areas will benefit greatly from data collected for other studies regarding the soil type, cover type, and the distribution and condition of wetlands.

The results of the *2012 Rare, Threatened, and Endangered Plant and Exemplary Natural Community Assessment* (Normandeau, 2013), and other related studies including Floodplain, Wetland, Riparian, and Littoral Vegetation Habitats Study (Study 27), Hydraulic Modeling Study (Study 4), Operations Modeling Study (Study 5), and the erosion studies (Study 1, 2, and 3) will assist in identifying suitable habitat, interpreting the toad data collected, and in drawing conclusions about preferred habitat characteristics and whether project operations affect this habitat.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Fowler's toad is considered an SGCN in Vermont, and a Species of Special Concern in New Hampshire. To date, no studies have been conducted to identify the location or size of Fowler's toad populations within the project-affected areas, or to understand if project operations could affect toad populations, if present. The 2012 Species Status Review (provided as Appendix B to VANR's study request document dated March 1, 2013) for Fowler's toad by the State of Vermont Endangered Species Committee indicates that Fowler's toad has been recorded in towns bordering the Connecticut River in both Vermont and New Hampshire. Fowler's toad was first reported and photographed in Vermont in 1983 in the Town of Hartford where it was reported as numerous. There was one 1985 report from Westminster, and a population in Vernon was well documented from 1994 through 2007. Additionally, there was one 2002 report from along the Saxton's River in Rockingham, VT.

In New Hampshire, Fowler's toad has been documented in Hinsdale (2002) and Westmoreland (2001) in Cheshire County (NHFG, 2010). No studies have been conducted to quantify the habitat occupied by Fowler's toad in the vicinity of the Connecticut River, or to identify apparently suitable habitat along the river, based on the literature.

PROJECT NEXUS

Project operations have the potential to affect Fowler's toad habitat that may be present. This species has specialized habitat requirements that may benefit from shoreline disturbance as a result of flooding and/or wave action. Hydraulic regimes that deposit sand and gravel along the shoreline and clean away vegetation may help to create suitable habitat for this species. The sandy, unvegetated shoreline, river banks, and floodplains may provide small pools for breeding and suitable habitat for aestivation and hibernation.

Fowler's toad undergoes regular short-term population fluctuations. Hydraulic regimes that promote habitat fragmentation, e.g., reduced flooding allowing substantial plant growth, may disrupt this species' ability to move between breeding and terrestrial sites and recolonize appropriate habitats. Results of this study could be used to identify important habitats for Fowler's toad, and to define the riverine processes that affect these habitats.

STUDY AREA AND STUDY SITES

The study area includes the shorelines and terrestrial lands of the Bellows Falls and Vernon impoundments, the Bellows Falls riverine project-affected area, and TransCanada lands below Vernon dam. The Wilder impoundment and Wilder riverine project-affected area are unlikely to support this species because these areas lie north of the northernmost Vermont record for Fowler's toad, and that report is the northernmost record in the Northeast, with the exception of a disjunct population in Canada. The precise study sites within the study area are to be determined, based on the results of a desktop assessment of potential habitat. Surveys will be conducted on TransCanada's fee-owned project lands, those flowage easement lands that may be hydrologically connected to the Connecticut River, and lands that are publicly accessible by boat or by foot. The survey will focus on likely breeding pools as indicators of Fowler's toad presence within the projects.

METHODS

This study will begin with a desktop analysis of existing data regarding the habitat available to Fowler's toad within the study area. Information that will be considered will include soil types, vegetation and cover type, and the locations and condition of existing wetlands in and directly adjacent to the project-affected areas. Sources of data that will be considered include relevant reports and maps created from concurrent studies as well as existing maps and aerial photos.

Records of historic and recent locations and extent of Fowler's toad in Vermont and New Hampshire will be requested from the relevant agencies. Fowler's toad requires temporary pools for breeding, and loose sandy or gravelly soils above the waterline but below the frost line, for aestivation and hibernation burrows. Dense vegetation impedes the ability of this species to burrow into suitable soils. The results of the desktop analysis will be ground truthed by field-checking a subsample of the areas identified as suitable. We will regularly contact VANR for reports of additional Fowler's toad observations throughout the field study period.

Fowler's toads are most effectively located by their calls during the breeding season. As requested by VANR, standard call surveys will be used to identify and map species occurrence. The methods describe below are based on Droege (undated) and Tupper et al. (2007):

- Likely breeding locations will be identified based on historic and recent records and the results of the desktop habitat suitability analysis. Of those likely breeding locations, whether or not they are potentially affected by project operations will be assessed. Those outside the project boundary and those that are not likely to be affected by project operations will be identified as potential habitats but eliminated from further survey and analysis.

- A survey route based on results of the desktop study will be created and field-checked to verify that breeding areas identified with the desktop appear suitable (ground truthing).

- Suitable breeding locations will be surveyed three times, roughly 2 weeks apart, during the survey period, which is late May through early July. The survey period may be extended further into July, if needed, to capture suitable air and water temperatures.

- Surveys will be conducted within 3 hours after sunset, with no to light winds, and water temperature of potential breeding ponds above 17.8°C. Light rain that does not interfere with listening is also a suitable survey condition.

- All survey conditions will be recorded along with survey results, including survey beginning and end times, weather conditions, water and air temperatures, and ambient noise levels.

- In the event that Fowler's toad is documented within the project area, the conditions in the breeding pool and the adjacent habitat where the toad is located will be documented. Information collected about the breeding pool will include pool location, size, and depth. The soil and substrate type, approximate elevation, vegetation type, hydrologic conditions, and a list of other animal species observed during the habitat data collection will be recorded for both the breeding pool and the surrounding habitat area.

- Decontamination procedures designed to comply with any VANR and NHFG standards for biomonitoring equipment will be applied to survey equipment used in breeding pools (i.e., boots, waders, nets, collection pans).

In the study request, VANR also suggested several additional methodologies that are not included in this study plan. VANR suggested that surveys could be conducted using nighttime wet road surveys, nearshore boat surveys, FrogLoggers, and environmental DNA (eDNA) sampling.

The call surveys may be conducted in part by boat if necessary to reach remote areas. Nighttime wet road surveys will not be used because call surveys can be conducted under a greater range of conditions and are more efficient, allowing a greater area to be surveyed. Based on the results of the mapping and preliminary surveys, up to 5 wildlife acoustic recorders (FrogLoggers is one brand) will be placed at the locations historically known to be occupied by, or potentially suitable for, this species. However, acoustic recorders will not be the primary method used for the project-wide survey because the call of Fowlers' toad is distinctive and easily perceived, making direct listening a more efficient option for surveying a large area. Although a relatively new method, eDNA sampling is an apparently effective method for detecting rare species in aquatic ecosystems (Ficetola et al., 2008; Goldberg et al., 2011). However, because it is a technique still undergoing development, there is not yet good data on how eDNA is transported and distributed by surface or groundwater flow and how long eDNA persists under varying conditions (Goldberg et al., 2011). Therefore, its value for identifying occupied habitats in riverine systems is uncertain and will not be included in this study.

ANALYSIS

The analysis will combine the results of the desktop study with the results of the call survey to determine the suitability of the project-affected areas for Fowler's toad, and the likelihood that the species is currently present in the study area. The analysis will define habitat requirements based on literature and field survey results; document/map currently suitable habitats; and ascertain whether these habitats are affected, positively or negatively, by project-related flows or other project-related activities.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

Call surveys are generally accepted as an efficient, accurate method for determining habitat occupancy by amphibians that vocalize as part of their breeding activities. Standard methodologies have been developed by USGS (Droege, undated), and call surveys are used by the North American Amphibian Monitoring Program (USGS, 2013) and by many states to inventory vocal amphibians.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. The report will summarize the desktop and field results, including maps of potential habitat, survey locations, and survey results showing whether operations of the projects are likely to have effects on suitable Fowler's toad habitat, and if those effects are likely to be positive or negative. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated. If Fowler's toad is state-listed as endangered by Vermont when the final report is completed, an internal and a public version of the final report will be prepared as needed, to comply with any requirement to hold the locations of occupied habitat confidential.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This study will be conducted in the first study year (2014). As noted in the methods section, suitable habitats will be identified through a desktop analysis prior to the summer 2014; field surveys will be conducted during the month of June, under appropriate weather conditions. Analysis of field data and potential model application to assess project effects will occur in the fall of 2014 and into 2015.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for the study is $56,000.

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Droege, S. Undated. Amphibian Calling Surveys. USGS Patuxent Wildlife Research Center, Laurel, MD. Available at: http://www.pwrc.usgs.gov/monmanual/techniques/amphibcallingsurveys.htm.

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REVISED STUDY 29

NORTHEASTERN BULRUSH SURVEY

RELEVANT STUDY REQUESTS

FWS-19; NHDES-15a, NHFG-15; NHNHB-01, -04; VANR-26; CRWC-16; Rock-03

STUDY GOALS AND OBJECTIVES

In their study requests relative to aquatic vegetation and habitats within the Wilder, Bellows Falls, and Vernon Project-affected areas, stakeholders specifically requested a survey for northeastern bulrush (*Scirpus ancistrochaetus*), a federally listed endangered species known to occur in one location within the Bellows Falls Project on a beaver flowage in Rockingham, VT.

The goal of this study is to assess the potential effects of project operations on northeastern bulrush within the Wilder, Bellows Falls, and Vernon Project boundaries.

The objectives of this study are to:

- document the presence or absence and status of previously documented populations of northeastern bulrush in the study area;
- survey for additional locations of populations of northeastern bulrush in likely habitats;
- estimate the elevation of identified populations of northeastern bulrush to daily operational flows and impoundment levels to assess the potential influence of project operations on those populations; and
- assess effects on populations from non-flow-related project operations within the project boundaries (e.g., recreation, agricultural leases).

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

Federal and state resource agencies described various jurisdictional resource management goals for this study in their requests, as summarized below:

FWS

- Northeastern bulrush is a federally listed endangered species. The goal for northeastern bulrush is species recovery for removal under the Endangered Species Act in accordance with the FWS' Northeastern bulrush (*Scirpus ancistrochaetus*) Recovery Plan (FWS, 1993).
- General goals for relicensing including ensuring that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives;

		and conserving, protecting, and enhancing habitats for fish, wildlife, and plants affected by the projects.
	•	General goals related to aquatic resources including protecting, enhancing, or restoring aquatic and riparian habitats; and minimizing project effects on water quality and aquatic habitat.
NHDES	•	State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	•	General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference the New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).
VANR	•	General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.
	•	VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them; and providing fish and wildlife-based activities including viewing, harvesting, and utilization of fish, plant, and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005).
	•	VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety. Goals reference the Vermont Fish and Wildlife Strategic Plan (VFWD, 2006).

ASSOCIATION WITH OTHER STUDIES

Other TransCanada studies addressing other federally listed species have been completed or are proposed, including studies for Jesup's milk vetch (*Astragalus robbinsii* var *jesupii*) (Normandeau, 2013a); a 2012 study of rare, threatened, and endangered plant species (Normandeau, 2013b); dwarf wedgemussel (*Alismodonta heterodon*) (Biodrawversity and LBG, 2012) and proposed in other study plans including the Dwarf Wedgemussel and Co-Occurring Mussel Study (Study 24); and Puritan tiger beetle (*Cicindela puritana*) in the Cobblestone and Puritan Tiger Beetle Survey (Study 28). In addition, Hydraulic Modeling and Operations Modeling (Studies 4 and 5) will provide information on potential effects on habitats for this species from project operations.

The bald eagle (*Haliaeetus leucocephalus*) is no longer listed under the Endangered Species Act, but continues to receive federal protection under the Bald and Golden Eagle Act. Ongoing studies of bald eagle nesting activity in the project area are conducted by the New Hampshire Audubon Society with financial support from TransCanada.

The aerial photographs collected for the Floodplain, Wetland, Riparian, and Littoral Vegetation Habitats Study (Study 27) will be reviewed to identify possible locations of new populations of northeastern bulrush, and to identify the land use in and adjacent to identified populations of this species. The Recreation Facility Inventory and Use & Needs Assessment (Study 30) will be reviewed in the event that northeastern bulrush populations appear to be affected by a recreational activity. Additional studies that will be used during the northeastern bulrush study will include the Instream Flow (Study 9), Hydraulic Modeling (Study 4), and Riverbank Erosion (Study 3) studies to assess the potential for water-level fluctuations to affect populations of northeastern bulrush within the project boundaries.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Northeastern bulrush is listed as endangered by FWS and the States of New Hampshire and Vermont. One record of northeastern bulrush is known to occur within the Bellows Falls Project boundary. While the specifics of its habitat preferences are poorly understood, northeastern bulrush, like other sedges, grows in wet areas – small wetlands, sinkhole ponds or wet depressions with seasonally fluctuating water levels. It may be found at the water’s edge, in deep water, or in just a few inches of water, and during dry spells there may be no water visible where the plant is growing (FWS, 1993b). The species appears to flourish in small ponded areas with full light availability, and relatively stable water levels, although many seemingly suitable habitats are unoccupied by northeastern bulrush.

The results of this study will establish baseline information on the distribution and habitat characteristics of northeastern bulrush populations within the project boundaries, and will assess the effects of project operations on the species. The assessment will consider the potential for existing project operations to influence surface and groundwater conditions at the northeastern bulrush sites.

PROJECT NEXUS

One record of northeastern bulrush is known to occur within the Bellows Falls Project boundary, but is located outside of the flow-related influence of operations. The northeastern bulrush was not found during the 2012 TransCanada study of rare, threatened, and endangered plant species (Normandeau, 2013b), which focused on habitats immediately adjacent to the river and directly affected by the projects’ flow-related operating range; however, that study did not include a survey specific to northeastern bulrush because FWS indicated that it was unlikely to be found within the geographic scope of that study. This new study will include surveys for northeastern bulrush within the project boundaries that are not subject to river and impoundment fluctuations. This approach will provide information that supports the two recovery strategies recommended in the FWS recovery plan for the species: 1) provide protection for known populations and 2) survey for new populations (FWS, 1993).

STUDY AREA AND STUDY SITES

The study area includes areas within the Wilder, Bellows Falls, and Vernon Project boundaries, including fee-owned properties and lands with flowage rights held by TransCanada. Although northeastern bulrush is only known to occur in the Bellows Falls Project area outside of the range of project operational flows, additional information will be sought from agencies and botanists who are expert in this species to identify possible new populations and habitats in other locations within the study area.

METHODS

Information on existing populations of northeastern bulrush and the habitats known to support the species will be gathered from state databases and botanical specialists for this species. Aerial photographs, soil survey data, and other remote sources of data will be reviewed to identify locations in which to search for new populations.

The appropriate state and federal collecting permits will be obtained prior to field sampling. Field surveys will include site visits to known and likely locations during the fruiting season when the species is best identified (August-September). Found populations will be documented according to Vermont NHIP and New Hampshire NHB protocols. Both protocols require data collection on the target species (e.g., phenology, population size, age structure and vigor, distribution, and general health), and the habitat in which the species is found (e.g., aspect, slope, canopy, topographic position, moisture regime, elevation, and associated plant species). Hydrologic inputs to each site will be qualitatively assessed from the site setting; surface water sources; and indicators of seepage, flooding, or disturbance. The limits of the population will be collected with GPS with submeter capabilities. Site elevations will be estimated from the LiDAR topographic contours. Photographs documenting the species and the habitat will be collected. If species identification is uncertain, specimen examples may be collected. Visual observations of land use in the vicinity of found populations will be noted.

Sites that are unoccupied in 2014 and that appear to provide similar habitat to sites supporting northeastern bulrush will be identified as potential sites. Because northeastern bulrush may not fruit every year, depending on environmental conditions, identifying potential habitat may be important for future surveys. At each potential site, a GPS point will be taken, and data on general habitat characteristics will collected, including hydrology, setting, vegetation communities, and elevation.

ANALYSIS

The results of the habitat and population surveys will be mapped and analyzed in GIS. The findings will be qualitatively assessed relative to activities within the project boundaries (both flow-related and non-flow related such as recreation, agriculture, development, and other land uses) that have the potential to affect the species or its habitat. Habitat characteristics such as hydrologic regime, setting, and elevation relative to project operations (via the two modeling studies) will be used to assess the potential effects of project operations. Other features such as surrounding land use, evidence of disturbance, proximity to development, and presence of invasive species will be used to assess the potential effects resulting from non-flow project activities and other sources, if relevant.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

Methods of rare, threatened, and endangered plant data collection, survey, and analysis described for this study are consistent with generally accepted scientific practice. Methods are similar to what was provided in the 2012 rare plant and community survey (Normandeau, 2013b).

DELIVERABLES

A report will be prepared that includes maps of locations of identified populations and unoccupied potential habitats for northeastern bulrush, documentation of findings, and an assessment of project effects.

A non-confidential draft study report summary will be provided after the research and analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in a final report with an explanation of any stakeholder comments not incorporated.

Results and non-confidential conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application. A stand-alone confidential report will be provided to FWS, New Hampshire NHB, and Vermont NHIP, in which specific locations and details of individual populations will be provided.

SCHEDULE

The field work for this study will be conducted during the northeastern bulrush growing season of the first study year (2014). Preliminary research and mapping will occur in the spring with field surveys conducted in August and September. A study report will be provided after the research and analysis is complete and the results are available.

COST ESTIMATE

The preliminary estimated cost for this study is approximately $23,000.

REFERENCES

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Falls, and Wilder Hydroelectric Projects. Prepared for TransCanada Hydro Northeast Inc.

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REVISED STUDY 30

RECREATION FACILITY INVENTORY, USE & NEEDS ASSESSMENT

RELEVANT STUDY REQUESTS

FERC-10; NPS-01; NHDES-01a, -01b, -01c; NHFG-01a, -01b, -01c; VANR-32; AMC-VRC-FRs-01; NEF-AW-01, -02; NEF-AW-AMC-02a, -02b, -02c; NEF-AW-AMC-05, ROCK-04, -05; TwoRiv-01

STUDY GOALS AND OBJECTIVES

Public comments during scoping meetings and input from FERC; NHDES; NHFG; VANR; NPS; recreational user groups, the Town of Rockingham, VT; and Two Rivers Ottauquechee Regional Commission indicate a strong public interest in recreation access and opportunities, and a belief that there may be undocumented or underrepresented user groups and recreation opportunities available in the projects. This study will address recreation resource opportunities, uses, and needs within the Wilder, Bellows Falls, and Vernon Projects. In addition, the study will include public recreation access opportunities at the Connecticut River from the upstream end of the Wilder impoundment to downstream limit of the Vernon Project.

The goals of this study are to:

- obtain information about the condition of existing recreation facilities and access sites at the projects and along project-affected reaches of the Connecticut River;
- obtain information about existing recreation use and opportunities, access, and present and future use estimates for sites within and in riverine sections between the projects;
- conduct an assessment of the need to enhance recreation opportunities and access at the projects;
- present the recreation use and opportunities at the projects within the larger context of regional opportunities;
- photograph views from public recreation facilities to document existing aesthetic conditions; and
- lay the foundation for preparation of a Recreation Management Plan (RMP) for the projects that will be included in the license applications.

Key objectives associated with the various components of this study are summarized as follows:

A. Recreation Facility Inventory

1. Identify existing information on recreation resources adjacent to and within the projects, and update existing data through site assessment and consultation with public and private recreation providers.

2. Provide a general characterization of regional whitewater-oriented recreational opportunities.

3. Provide an inventory of informal and formal public and private waterfront recreational sites/facilities within and adjacent to each project boundary including within the Bellows Falls bypassed reach and riverine reaches downstream of the Wilder and Bellows Falls Projects.

4. Create detailed GIS-based map layers showing recreation sites/facilities, and populate a database including information identified in objectives 1-3 above.

5. Prepare a recreation sites/facilities inventory summarizing the information collected and categorize by recreation type or interest; distinguish whether or not facilities are project facilities and if not identify the site manager, to the extent practical.

6. Photodocument representative views of each inventoried recreational site to capture current aesthetic resources.

B. Recreation Use and Needs Assessment

1. Collect data on visitation levels, activities, and trip frequencies related to recreational use (including active and passive recreation types) and user preferences and perceptions (e.g., adequacy of facilities, crowding) at existing formal and informal public access sites within the project boundaries.

2. Collect information (e.g., activity type and resource needs, visitation levels and trip frequency, and obstacles to recreation in project areas) regarding recreational use and user preferences of uncommon and potential user groups.

3. Characterize existing and potential recreational uses at the projects by season and activity.

4. Characterize current user preferences and any identified needs.

5. Summarize parking lot utilization, and identify sites that receive heavy use. If TransCanada project recreation areas are recorded at maximum capacity or are likely to be so within the term of a new license, examine opportunities for TransCanada to repair or upgrade its sites.

6. Summarize current recreation use from information collected.

C. Future Recreational Use Assessment

1. Collect information regarding local and regional population trends and trends in recreation activities throughout the Upper Connecticut River Valley in Vermont and New Hampshire.

2. Document current trends in recreation and use available in accepted literature to make future use estimates.

3. Estimate future use levels (by activity) at each project.

4. Identify if changes in TransCanada's public access facilities will be needed and where those facilities would be beneficial.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

NPS	• The Connecticut River has been designated a National Blueway, part of the America's Great Outdoors Initiative. Among the stated goals are "to advance a whole-river, water-based approach to conservation, outdoor recreation, education, and sustainable economic opportunities in the watersheds in which we live, work, and play."
NHDES	• State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	• General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference the New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).
VANR	• State water quality standards for designated uses of Class B waters relative to levels of water quality that fully support all recreational uses.
	• General policy related to protection of the quality of state waters with scenic, recreational, cultural, and natural values; balance competing uses; provide improved public access for water-based recreational opportunities. Policy references the 1993 Vermont Recreation Plan (VANR, 1994).

Also, the project PADs note that the states of New Hampshire and Vermont have published Statewide Comprehensive Outdoor Recreation Plans (New Hampshire, 2007; Vermont, 2005) containing goals related to recreation resource management throughout each state.

ASSOCIATION WITH OTHER STUDIES

This study will supply context and background for the Whitewater Boating Flow Assessment – Bellows Falls and Sumner Falls (Study 31), and the Bellows Falls Aesthetic Flow Study (Study 32).

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Section 3.10.3 of the PAD for each project provides a summary of FERC Form 80 Recreation Use Report annual visitation estimates for 2008. Section 3.10.2 provides a general description of public recreation facilities, activities, and demand at the projects. However, the PADs do not provide detailed information on the condition of existing facilities or type or location of various uses. Site-specific information on visitor perceptions and identified needs at the projects, current use, and whether existing access facilities in the area are meeting current and expected future recreation demand has not been collected.

PROJECT NEXUS

Project impoundments, tailwater areas, and the bypassed reach at Bellows Falls include some inherently attractive recreation features. An analysis of existing recreation use and access at the projects will help form the basis for determining the projects' public recreation access opportunities. Also, an assessment of the current level of recreation use will provide information necessary to develop an RMP for efficient management of project recreational components over the term of any new licenses.

STUDY AREA AND STUDY SITES

The study area for the recreational facility inventory extends from the upstream end of the Wilder impoundment to the downstream limit of Vernon Project lands, including Stebbins Island. The study area for the recreational use and needs assessment and future use estimates includes the Wilder, Bellows Falls, and Vernon Projects (lands and waters within the project boundaries). Figures 3.10-1 of the Wilder, Bellows Falls, and Vernon PADs show these publically accessible recreation sites. Specifically, the study area includes the project impoundments and existing formal and informal public recreation areas including TransCanada access areas, state and municipal lands and access areas, and commercial recreation areas (marinas) adjacent to the projects that provide water- and land-based recreation opportunities for the general public. The study will draw on information gathered from public recreation area visitors and residents from neighboring communities.

METHODS

Several methods will be used to collect current and estimate future recreation use and needs for the Wilder, Bellows Falls, and Vernon Projects land and waters potentially affected by project operations. The study will assess data on recreational use and needs gathered during both peak and non-peak seasons.

A. Recreation Facility Inventory

The recreation facility inventory (Attachment 30-A) will be used for site visits to each publicly accessible site within the project boundaries to document existing facilities and resources. Visits to documented facilities and resources will also be made to public riverine access sites between Wilder and Bellows Falls and between Bellows Falls and Vernon. Table 30-1 summarizes all sites that will be inventoried.

Table 30-1. Publicly accessible sites to be included in the Wilder, Bellows Falls, and Vernon recreation facility inventory.

Wilder Project	Bellows Falls Project	Vernon Project
Newbury-Haverhill Bridge Access	Wilgus State Park	Putney Boat Landing
Bedell Bridge State Park	Ashley Ferry Boat Landing	Dummerston Landing
Bugbee Landing Access Point	Hoyts Landing	(Chesterfield) River Road Access
Orford Boat Landing	Patch Park	Old Ferry Road Access
Richardson Conservation Land	Charlestown Boat Launch and Picnic Area	Retreat Meadows Boat Launch
North Thetford Landing	Green Mountain Marina	West River Marina
Hewes Brook Boat Launch	Herrick's Cove Boat Launch and Picnic Area	Norm's Marina
Ompompanoosuc Launch	Pine Street Boat Launch and Portage Trail Take-Out	Hinsdale Access
Wilson's (Fullington) Landing	Bellow Falls Fish Ladder Visitor Center	Fisherman Access Area
Ledyard Canoe Club	Bellows Falls dam portage put-in	Broad Brook Access
Norwich Landing	Bellows Falls bypassed reach	Prospect Street Launch
East Wilder Boat Launch		Vernon Canoe Portage
Chambers Preserve		Vernon Glen

Wilder Project	Bellows Falls Project	Vernon Project
Cole Park		Vernon (Governor Hunt) Recreation Area & Boat Launch
Hartford (Wilder) Picnic Area at Kilowatt Park		Vernon Neck Open Space
Wilder dam (Olcott Falls) Boat Launch		
Fishladder and Angler Parking		
Lebanon (Wilder dam) Picnic Area Vista and hiking trails		
Wilder dam portage and downstream natural areas		
Downstream Access Sites		
Lyman Point Park Launch	Connecticut River Cartop Access (Westminster Bridge/Cold River Hand Launch)	
Two Rivers Park		
Lebanon Public Boat Launch		
Blood’s Brook Launch (a.k.a True’s Landing)		
Ottauquechee Launch		
Sumner Falls (Hartland Rapid)		
Cornish Boat Landing		
Connecticut River Trail Campsites inside Project Boundary		
Harkdale Farm	Wilgus State Park	Windyhurst
Vaughn Meadows	Student Conservation Association (SCA)	Wantastiquet - Hinsdale Canoe Rest Area
Bugbee Landing	Lower Meadow	Stebbins Island Canoe Rest Area
Underhill Camp		
Pastures Campground		

Wilder Project	Bellows Falls Project	Vernon Project
Birch Meadow		
Roaring Brook		
Gilman Island		
Gilman Island -Titcomb Cabin		
Campsites downstream of Project Boundary		
Burnap's Island		
Burnham Meadow Campsite		

Amenities at each site, such as number and type of boat ramps, presence and type of restrooms, types of activities supported, parking spaces, and parking surface, will be recorded along with digital photos and GPS points. This inventory will identify and characterize public facilities and resources, including any barrier-free sites/facilities, and the conditions of those facilities. River access sites will be visually assessed and photographed to record any opportunities or challenges for hand-launched boats (e.g., canvas canoe). Attachment 30-B shows the inventory site use condition assessment form that will be used to systematically characterize the physical conditions of the sites as well as visual evidence of use and possible related damage. Survey staff will be trained to record data following the prompts given in the forms to reduce subjectivity and maintain consistency across all access points. The inventory will be one of the first tasks of the study.

The inventory will include the feasibility of incorporating shorter and safer portages (i.e., for Bellows Falls a path that reduces boater proximity and time near NH State Route 12, and for Wilder and Vernon potentially shorter routes). Staff will work within the existing conditions to evaluate potential options by reviewing land ownership information surrounding the dams (and bypassed reach for Bellows Falls) and investigate shoreline slope conditions (e.g., steepness, length) for alternative take-out and put-in options at each dam on both sides of the river that could serve as alternatives to current routes.

The City of Lebanon, New Hampshire, indicated that it has plans to develop River and Westboro parks along the Connecticut River, which may have a nexus to the Wilder Project. These parks do not currently exist; however, once constructed they could provide recreation opportunities adjacent to the river. To capture the potential future parks in the study, consultation with the City and review of the conceptual site plans for those areas will be included in the recreation facility inventory.

The results of the inventory will provide baseline information regarding existing recreation facilities and resources at the projects and along project-affected riverine reaches. The inventory information will be assessed in conjunction with information obtained through the visitor intercept survey (see below).

The expected results of the inventory effort will be:

- inventory of recreation sites and opportunities within and adjacent to each project;
- digital photographs of each recreation site; and
- GIS map layers with links to digital photos and inventory information.

B. Recreation Use and Needs Assessment

The use and needs assessment will document recreation activity types known to occur or potentially occurring at each project and riverine reaches between the projects. Three components will be used to collect existing and potential (future) recreational visitor use data: 1) existing public use (traffic counters, spot counts, and visitor intercept interviews); 2) potential visitors (mailed and/or online questionnaire); and 3) use from other shoreline operators (e.g., publicly accessible marinas and state parks [interviews and/or shared recreation data]). Data will be collected primarily during the peak season (for the purposes of this study defined as May 1 to October 15) and to a limited extent during the off-season.

Existing Public Use

Traffic counters, spot counts, and visitor intercept interviews from the public access points listed above will be used to estimate current recreation use and activity levels at each project's public access sites.

Traffic counters will be installed at public access sites within the project boundaries that are conducive to this form of data collection. These are sites with a clearly designated entrance and exit. An assessment will be made in the field regarding the suitability of using a traffic counter at each site. Based on a preliminary desktop analysis, it appears most sites would have an appropriate location to place a traffic counter; however, potential traffic counter locations must be field-verified. Researchers intend to install traffic counters at as many of the recreation sites listed in Table 30-1 as possible. Traffic counters will be installed with the intent to capture data year-round; however, adjustments may be necessary to compensate for vandalism or seasonal operations (e.g., site closure, protection from snow plows).

Spot counts and interviews will be conducted at all public access sites listed in Table 30-1. Spot counts and interviews will be collected year-round following the methods for peak and non-peak seasons below. Spot counts and interviews will be collected at river access campsites during three weekends in the peak season to capture through-boaters. These users may also be captured when taking out as they end their trip or portage the dams. Spot counts will collect data on the number of occupied parking or campsite spaces, recreational activities observed and use numbers, and general climate conditions. Attachment 30-C is a sample spot count data collection form. Atypical uses not listed on the spot count form (e.g., observation of school groups) will be recorded in the notes section and tabulated at the conclusion of the field work.

Intercept surveys will be conducted with visitors to collect data on people's use of recreation sites, their attitudes concerning recreation needs and opportunities, safety concerns, and perceptions of site aesthetics. Survey questions will ask visitors about group size, activities participated in, duration of and frequency of visits, primary activity, satisfaction, perceptions related to operation of the projects, and insight into site or project needs. Attachment 30-D shows the on-site interview questionnaire. The date and time of the interviews and the information collected on the public's perceptions of impoundment levels or flows will be correlated to the actual levels during the interviews. Key aesthetic places and areas will be identified through interviews and then will be photographed. The goal of each site visit is to capture use numbers from traffic counts, characterize them with spot counts, and obtain as many interviews as possible to get a representative sample of the recreating public and characterize their uses, opinions, attitudes, and experiences.

Peak Season

A stratified random sampling scheme, such as by month, time of day, and location, will be used to gain representative responses from visitors at public access sites accessible by car, using the following methods:

- interviews will be collected simultaneously with spot counts;
- a sampling day (8 hours) will begin either 1 hour after sunrise or end 1 hour before sunset[3] (calculated from sunrise/sunset times for Burlington, VT) and will focus either on the AM or PM time period;
- start times weighted AM=0.33, PM=0.66 over the entire study;
- routes between sites will be the same; however the starting location will change each sample day so as to cover each site at different times throughout the day during the study;
- the Connecticut River will be separated into zones to ensure each zone receives equal coverage during a single survey day;
- due to its length and the number of sites, sites within Wilder and downstream to Bellows Falls will be separated into two zones (north and south);

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3 For reference, on June 21 sunrise is 5:08 AM and sunset is 8:41 PM

- peak season sampling will occur within each zone 9 days a month; 6 weekend and 3 weekdays will be randomly selected (October will be prorated);
- one day of each peak season holiday weekend will be sampled (Memorial Day, 4th of July [Friday in 2014], and Labor Day);
- only persons 16 years of age or older will be surveyed;
- a single person will be randomly selected from a group (e.g., closest birthday to survey date); and
- routes and sampling times may be modified to enhance survey collection as study progresses.

Off-Season

To accurately capture winter and spring recreation use of project area recreation sites beyond traffic counts, spot counts and interviews will be conducted at a limited number of sites during January, February, March, and April. Sampling events will generally follow the same methods as the peak season sampling (e.g., start/stop times, trip direction, interview methods); however, the exact number of sites may be less due to seasonal closures (e.g., gated access, or not snow plowed), which will be investigated during the desktop and inventory stages of the study. Sites that remain open year-round will be visited at least once a month during this period to confirm off-season uses, identify popular locations, and determine access area use levels. If vehicles are observed in the access areas but users are not present after a reasonable amount of time, a numbered interview (for tracking purposes) will be left on the windshield with a self-addressed, stamped envelope for the user to complete and return.

Potential, Uncommon, and Non-Visitors (Regional Residents)

On-site interviews generally capture common activity types and potentially miss groups with unique recreation resource needs. These potential, uncommon, or non-user groups (e.g., adjacent residential landowners, ice fishing/snowmobile uses, hunters) will be surveyed using a mixed mode (mail and internet) approach inquiring about their recreational uses and needs of the Connecticut River within the projects as well as reasons for not visiting the projects. The mixed mode survey will follow the Dillman Method or modified Dillman Method (Dillman, 1978), and include frequency and duration of visits to the projects, qualitative ratings of existing public access and recreation facilities in the project area, and reasons for visiting or not visiting the projects for recreation. Approximately 2,400 residents of Caledonia, Orange, Windsor and Windham counties in Vermont and Grafton, Sullivan, and Cheshire counties in New Hampshire who reside at varying distances from the projects and who may recreate at project impoundments and downstream riverine reaches will be invited to participate in the recreation survey. Names and addresses will be purchased from a firm specializing in the sale of survey sample mailing addresses. These residents will be mailed an initial introductory letter, a follow-up hard copy of the questionnaire, and subsequent follow-up post cards to encourage responses. Residents will be provided the option to respond using a mail survey or a web-based survey. Surveys will be coded so web entries can be tracked against unique mailing criteria to limit duplicate entries (both hard-copy and web-entry), or ballot stuffing from forwarded emails, or sharing of hard-copy surveys among survey recipients.

Attachment 30-E shows the potential, uncommon, and non-user questionnaire. Distribution within each county will be based on the proportion of the study area population in each county. Based on the study area population and estimated return rates, 2,400 individuals will be surveyed. This sample size assumes a 95 percent confidence level with a 5 percent confidence interval. The actual confidence interval will be calculated and reported with the final results.

Needs Assessment

The needs assessment will address: 1) the suitability of whitewater boating in the bypassed reach of Bellow Falls; 2) existing boating opportunities within the project areas (including at impoundments and immediately downstream of dams); 3) the feasibility of providing additional public access at the impoundments and riverine reaches (potential locations, type of facilities and access, and any associated costs); 4) visitor perceptions of the adequacy of recreation facilities and access in the project areas during summer, fall, and winter sport seasons; and 5) currently proposed recreation facility improvement projects near each impoundment.

Expected results of the use and needs assessment will be:

- annual recreation use estimates by activity type for each project;
- visitor profile information including results of interviews and mixed mode surveys;
- characterization of existing recreational visitation based on the assessment of information gathered via spot counts, traffic counter information, and available use information from recreation facility providers;
- characterization of existing recreational use and user preferences based on intercept surveys and mail/internet survey information; and
- assessment of visitor perceptions of project operations and management (e.g., fluctuating reservoir levels, minimum flow releases) on recreation and recreation opportunities at the projects.

C. Future Use Assessment

Future use estimates will calculated for each project by assessing future demand for recreation activities and population trends for the expected term of new licenses (to year 2050). Population estimates for the communities surrounding the projects will be obtained from the Vermont and New Hampshire state agencies. Growth in recreation activities and recreation use projections for the anticipated growth in recreational use through 2060 will be developed using *Outdoor Recreation in American Life: A National Assessment of Demand and Supply Trends* (Cordell et al., 1999), *Outdoor Recreation Participation in the United States – Projections to 2060* (Bowker et al., 2012), and *Outdoor Recreation Trends and Futures: A Technical Document Supporting the Forest Service 2010 RPA Assessment* (Cordell, 2012). Current use estimates will be projected with indexed values of expected changes in the number of recreation days for given activities at the projects to estimate future recreation use in the project for 10-year increments out to 2050.

The expected results will be:

- data tables of expected population growth surrounding the projects in 10-year increments to 2050; and
- data tables of expected activity use levels for each project in 10-year increments to 2050.

ANALYSIS

Information acquired in this study will be used to characterize and quantify recreation opportunities and conditions of recreation facilities, activity types, and levels of use by season, parking lot use through peak and weekend periods, and visitor perceptions and recommendations. It will also be used to estimate future activity levels and lay the groundwork for a draft RMP. Results from the Bellows Falls inventory and suitability work will also inform the Whitewater Boating Flow Assessment Study (Study 31).

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methods to be used in this study are consistent with professional practices. The overall approach is commonly used in FERC relicensing proceedings and is consistent with generally accepted methods used by federal and state agencies for conducting recreation inventory, use, and needs studies. In addition, the methods are consistent with the FERC study request.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This will be a 1-year study conducted during the first field season (2014). Desktop and pre-field work will begin in late 2013, after FERC's study plan approval. Field work will focus on the peak recreational season with exact start and stop dates to be determined in consultation with the recreation working group. Spot counts, intercept interviews, and traffic counters will be scheduled during every calendar month with the greatest effort occurring during the peak recreation season from May 1 through September 30, 2014.

LEVEL OF EFFORT AND COST

The estimated budget for the study is $390,000.

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Attachment 30-A: Recreation Facility Inventory Form

Site Name:
Photos:
Location:
Facility Type:
Owner:
Manager:
Staffed:
Peak season maintenance schedule:

Acreage:
Gated:
Season/Hours:
Entrance Fee(s):

Primary Uses:

Parking

Lot name/identification if more than 1:__________________________
Day use fee:

Vehicle spaces:	**Parking lot type:**
Vehicle w/trailer spaces:	**Parking lot length:**
ADA designated spaces:	**Parking lot width**
Total parking spaces:	
Notes:	

Boating

Ramp name/identification if more than 1:__________________________
Launch fee:

Boat Ramp:	**Y/N**	**Ramp lanes:__________**	**Condition Assessment**
Boat Ramp Barrier Free:	**Y/N**		
Boat Ramp Materials:			
Boat/Courtesy Dock:			
No. of Dock Slips:			
Suitability of site for hand launching:			
Notes:			

Fishing

Formal Angling: Y/N	**Type:**	**Condition Assessment**
Bank Angling: Y/N	**Approximate length:**	
Common Ice Fishing Access Point Y/N		
Notes:		

Camping, Swimming, Picnic, View Point, and Trail Amenities

Number of campsites:	**Number of barrier-free campsites:**	**Condition Assessment**
Camping fee:		
Camping area acreage:		
Swim beach: Y/N	**Swim beach acreage:**	
Trail names	**Miles**	
a.		
b.		
c.		
Number of picnic tables:	**Number of barrier-free tables:**	
View Point/Vista: informal/formal		
Playground: Y/N		
Grills:	**Fire Pits:**	
Garbage cans:	**Dumpsters:**	
Other amenities:		

List of signs on site and sign wording:
(photograph)

Comments:

Attachment 30-B: Site Condition and Visitor Use Form

Text in the various ratings are examples of notes field staff could make during the evaluation. Staff will also add specific notes that informed their decision. Photos will be used to support the evaluation in the final report.

Facility site condition evaluation categories and criteria (filled out for each site).

Variable	0-Poor	1-Fair	2-Good
Roads & Parking (circulation and condition of surface paving)	All surfaces are in disrepair and need of immediate reconditioning or replacement. Current conditions create safety hazards.	Need for improved maintenance and repair in some areas. No major safety concerns.	All surfaces in excellent condition and well maintained. No rehabilitation required.
Recreation Site Amenities (condition of vehicle spur, picnic tables, fire ring/grills, boat ramps, etc.)	Facilities require immediate repair or replacement. Little evidence of recent maintenance.	Some facilities damaged or in need of replacement. Could be accommodated through routine maintenance.	Facilities generally in good condition and well maintained.
Recreation Site Buildings (condition of restrooms, maintenance buildings, and other structures)	Structures in disrepair requiring immediate attention. Significant rehabilitation likely. Problems could include rot, leaks, and sagging roofs.	Some structures need minor repairs, such as painting or replacement of roof/shingles. Repairs should be made, but are not needed immediately.	All structures appear in sound, well maintained condition. No significant problems observed.
Environmental (river buffers, direction of runoff, presence of Best Management Practices)	All surfaces drain directly to river with riparian buffer less than 2 feet	Riparian buffer between 2 and 5 feet. Portions of impervious surfaces drain to temporary pond or immediately away from Connecticut River	Riparian buffer >5 feet; impervious surfaces designed to move runoff away from river into stormwater ponds; site designers incorporated environmental design into facility layout.
Signs (presence/condition of project and recreation signs)	Signs do not exist or require immediate repair or replacement.	Some signs damaged or in need of replacement.	Signs generally in good condition and well maintained.
Notes:			

Based on the rating of each variable/site component in the table above, an overall facility evaluation score will be calculated using the following scale.

- Score = 9 to 10: Excellent condition
- Score = 6 to 8: Good condition - requiring routine care/maintenance
- Score = 3 to 5: Fair condition - may require some rehabilitation

Score = 0 to 2: Poor condition - requires immediate rehabilitation work or replacement

Visitor Use-Visible Impacts Form

Visitor use impacts - categories and criteria (filled out for each site)

Variable	0-Low Impact	1-Moderate	2-High Impact
Presence of litter, broken glass, fishing line, etc.	No evidence of litter, broken glass, or fishing line; Debris from high flows not included	May be a few pieces of litter clearly visible but easily transported to trash can; maybe a broken glass or other more difficult litter to pick up but not extensive	Extensive litter throughout site that would take more than 1 hour to remove; multiple broken bottles or areas with difficult litter to remove
Dumping	No large items or bulk piles of trash	1 or 2 large items left on purpose (not flow-related)	Clear intentional dumping, regularly observed, trash bags, appliances, furniture, etc.
Tree cutting, damage, or vegetation clearing	Vegetation appears natural with no human disturbances	Areas less than 5 feet cleared for campfires, etc.; small branches clipped for paths in select areas	Areas more than 5 feet cleared for open space, both small and large branches removed to expand the site
Inadequate clearance around fire pits/rings	Appropriate clearances and distances from water	Fire rings between 50 and 20 feet from water; adjacent to trees/vegetation or infrastructure	Multiple fire rings under low hanging tree canopy, less than 20 feet from water
Visible off-highway vehicle use/tracks	No visual evidence	Old tracks may be visible in dried mud or starting to be revegetated with grasses, maybe a single, fresh track around the perimeter	Multiple, fresh tracks and mud tracked across site; new damage to vegetation and built ramps, jumps, or other modifications to the site's landscape
Trampled vegetation, bare ground, compacted soils	No bare places in the vegetation outside designated areas	Spotty bare patches near main trails or access points, seasonal revegetation possible	Well-worn, bare areas throughout the site with little to no chance of revegating without serious effort
Human waste, toilet paper	No evidence of toilet paper, human waste or negative smells	Faint negative smells; singular location of human waste in vegetation	Multiple scatterings of toilet paper and areas of human waste; strong, consistent negative smells

Based on the rating of each variable in the table above, an overall visitor use impact score will be calculated for the facility using the following scale:

- Score = 10 to 14: Very poor condition – requires immediate attention
- Score = 6 to 9: Fair condition – may require some rehabilitation
- Score = 3 to 5: Good condition – requiring routine care/maintenance

Score = 0 to 2: Excellent condition – routine monitoring at this time

Attachment 30-C: Spot Count Data Collection Form

Date & Time___________ **Name**______________
Location_______________
Temperature___________
Weather: Sunny/Humid/Partly Cloudy/Cloudy/Fog/Drizzle/Rain

How many people are:

Picnicking		Bank/dock Fishing	
Visiting Beach (swim/sunbathing)		Hiking	
Using Playground		Viewing Wildlife	
Sightseeing		Hunting	
Walking			
Other:			

How many campsites are occupied?______
No. of interview requests denied_________

Number of drive-throughs (people who didn't get out of vehicle at access area)________

Comments:

Vehicle Information:

License Plate (State)	Number
VT	
NH	
MA	
ME	
NY	
Other:	

Number of Launches Observed:

Motorboat	
Sailboat	
Kayak	
Jet Ski	
Canoe	
Raft	
Scull	
Other:	

Parking Area		Vehicles w/out Trailers	Vehicles w/Boat Trailers	Vehicles w/Jet ski trailers	Vehicles w/car-top gear	Empty Trailers (no vehicle)	Total parking spaces filled
1							
2							
3							
4							

Locations with multiple parking lots	Parking Lot Name
	Main Boat Ramp 1
	Remote Boat Ramp 2
	Remote Boat Ramp 3
	Picnic Area
	Boat Ramp
	Picnic/Beach
	Boat Ramp
	Picnic/Beach
	Overflow Boat Ramp
	Boat Ramp_1
	Boat Ramp_2
	Picnic/Ranger office
	Fishing Pier

Attachment 30-D: On-Site Intercept Survey

Hello, my name is _____________ and I am conducting a survey with visitors to the Wilder, Bellows Falls, or Vernon Project areas and the riverine sections between the reservoirs on behalf of TransCanada. This information will be used as an aid in understanding more about land- and water-based recreation in the area. The survey will take about 10 minutes, and your responses will be kept confidential. Thank you for your time and input.

1. Date: _________________

2. Location: _____________________________

3. Current Weather: Sunny/ Partly Cloudy/Cloudy/Foggy/Drizzle/Rain

4. Today's Temperature: __________

5. Time: _________________

6. Surveyor: ______________

---

7. Have you previously been interviewed as part of this study?
   Yes – thank you for your time. We are only interviewing each person once in this study.
   No - CONTINUE

8. How many people are in your group today (including yourself)? ____________

9. How many vehicles did your group come with? _____________

10. Have you ever visited PROJECT before? Yes No

11. If yes, in a typical year how many times do you visit PROJECT for recreation __________(times/year)

12. What is your primary motivation for coming to this site today?______________________________

13. What is your zip code?___________________

14. On this trip, are you staying overnight in the area?
    Yes – How many days is your trip?_________
    No – How many hours will you be spending in the area recreating today?____________

15. Which of the following activities did you participate in on this trip? (mark all that apply)

ON THE WATER	ON SHORE
Motor boating (not fishing)	Fishing from shore
Fishing from boat or ice fishing	Wildlife viewing; birding
Waterskiing/tubing	Sightseeing/driving for pleasure
Jet skiing/personal watercraft use	Picnicking/family gathering
Canoeing/kayaking – flat water	Hunting
Canoeing/kayaking - whitewater	Tent/vehicle camping
Multi-day float trip	Bicycling/mountain biking
	Walking/hiking
Sculling	Swimming/sunbathing from shore
Swimming/sunbathing from a boat	

Tubing	
Snowmobiling	
Cross-country skiing/snowshoeing	
Other:	

16. Of the activities listed above, what was your primary activity on this trip? ______________________

17. We are also interested in what activities you participate in during other visits throughout the year. Please mark all the activities by season that you participate in while visiting Wilder, Bellows Falls, or Vernon reservoirs or the areas downstream (mark all that apply)

ACTIVITY	**Summer** (Jun, Jul, Aug)	**Fall** (Sept, Oct, Nov)	**Winter** (Dec, Jan, Feb)	**Spring** (Mar, Apr, May)
ON THE WATER				
Motor boating (not fishing)				
Fishing from boat or ice fishing				
Waterskiing/tubing				
Jet skiing/personal watercraft use				
Canoeing/kayaking – flat water				
Canoeing/kayaking - whitewater				
Multi-day float trip				
Sculling				
Swimming/sunbathing from a boat				
Tubing				
Snowmobiling				
Cross-country skiing/snow shoeing				
ON SHORE				
Fishing from shore				
Wildlife viewing/birding				
Sightseeing/driving for pleasure				
Picnicking/family gathering				
Hunting				
Tent/vehicle camping				
Bicycling/mountain biking				
Walking/hiking				
Swimming/sunbathing from shore				
Other:				

18. Overall, how satisfied are you with the **number of** recreation facilities and opportunities (please circle one number)?

1	2	3	4	5	6	7	8	9
Extremely satisfied		Moderately satisfied		Neutral	Slightly satisfied			Not at all satisfied

19. If not extremely satisfied, what additions, changes, or improvements would make you more satisfied?____________________

20. At what location(s) are these recreation facilities needed? ______________________________

21. Please rate your level of satisfaction with the **condition of the facilities** that you used (please circle one number).

1	2	3	4	5	6	7	8	9
Extremely satisfied		Moderately satisfied		Neutral	Slightly satisfied			Not at all satisfied

22. If you were not extremely satisfied, what changes or improvements would make you more satisfied?________________

23. Overall how satisfied were you with the **reservoir water level (or flow if downstream)** during this visit (please circle one number)?

1	2	3	4	5	6	7	8	9
Extremely satisfied		Moderately satisfied		Neutral	Slightly satisfied			Not at all satisfied

24. Did fluctuating water levels (either at Wilder, Bellows Falls, or Vernon reservoirs, or immediately downstream) affect your recreation experience today?

YES *CONTINUE WITH FOLLOW UP*

NO *SKIP TO QUESTION 28*

25. What type of fluctuation did you experience? (check one)
Rising
Lowering
Both

26. Briefly explain how the fluctuation you are thinking of positively or negatively affected your recreation experience?

____

27. In general, would you prefer fluctuations that were higher, lower, or about the same (check one)?
a. much lower fluctuations
b. slightly lower fluctuations

c. about the same; current situation is appropriate for my uses
d. slightly higher fluctuations
e. much higher fluctuations

28. Did you check public flow information (e.g., USGS website, American Whitewater website, or other sources) or the TransCanada flow phone prior to visiting today?

a. Yes
b. No
c. Didn't know it existed

29. Please choose the response that best describes how **safe** you felt **at this site** today?

1	2	3	4	5	6	7	8	9
Extremely Safe		Safe		Neither safe nor unsafe		Unsafe		Not at all safe

30. If you answered unsafe or not at all safe (7, 8, or 9), why did you not feel safe? ____________________

31. How would you rate the scenery at this location?

1	2	3	4	5	6	7	8	9
Extremely appealing		Appealing		Average		Unappealing		Not at all appealing

32. If you answered less than extremely appealing, what detracts from the scenic/aesthetic quality of this location?
____

33. What adds to the scenic/aesthetic quality of this location? __________________________________

34. Now think of scenic areas around THE PROJECT. What are the top three attributes of those areas that make them scenic? (e.g., natural setting, shoreline features, striking or rare natural features, etc.)

Location	**Attribute**
a.	
b.	
c.	

35. Male Female

36. (check one)

Age	**Race**
18 – 24	White
25 – 34	African American
35 – 44	Hispanic or Latino
45 – 54	Asian
55 – 59	American Indian or Alaskan Native
60 – 64	Native Hawaiian and Pacific Islander
65 – 74	Other:
75 – 84	Decline to answer
85 and over	
Decline to answer	

THANK YOU FOR YOUR TIME.

Attachment 30-E: Potential Visitor Questionnaire (mail/internet survey)

TransCanada is interested in learning the opinions of potential recreation visitors to the Connecticut River around Wilder, Bellows Falls, and Vernon reservoirs and the areas immediately downstream of them. TransCanada is conducting on-site interviews at public recreation areas; however, these visits may not capture all the potential users visiting these sections of the river. To the best of your ability, please respond to the questions below. This information will be used as an aid in understanding more about land- and water-based recreation in the area. The survey will take about 10 minutes, and your responses will be kept confidential. Thank you for your time and input.

---

1. Home zip code ____________

2. During the past year (Labor Day 2013 through Labor Day 2014) did you or members of your household participate in outdoor recreation activities at Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream? *CHECK ONE*

a Yes ☐*SKIP TO SECTION 1*

b No ☐

3. Why did you or members of your household **not** participate in recreation activities at Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream? *FILL IN THE BLANK*

____

____

____ ☐*SKIP TO SECTION 2*

____

____

SECTION 1
Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream

This section contains questions about how you or members of your household typically used Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream areas for recreation during the past year, from Labor Day 2013 through Labor Day 2014. If you don't recall an answer exactly, please give us your best estimate.

4. What was the primary motivation for choosing to recreate in these reservoirs or immediately downstream during the past year?

5. What was the **PRIMARY** outdoor recreation activity that you or members of your household participated in at Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream during the past year (Labor Day 2013 through Labor Day 2014)? *PLEASE CHECK ONLY ONE BOX FROM THE LIST BELOW.*

Motor boating (not fishing)	Fishing from shore
Fishing from boat/ice fishing	Wildlife viewing/birding
Water skiing/tubing	Sightseeing/driving for pleasure
Jet skiing/personal watercraft use	Picnicking/family gathering
Canoeing/kayaking – flat water	Hunting
Canoeing/kayaking - whitewater	Tent/vehicle camping
Multi-day float trip	Bicycling/mountain biking
	Walking/hiking
Sculling	Swimming/sunbathing from shore
Swimming/sunbathing from a boat	Snowmobiling
Tubing	Cross-country skiing/snow shoeing
	Other:

6. Typically, what was the primary season in which you or members of your household participated in outdoor recreation activities the most at Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream during the past year?
CHECK ONE FOR EACH OF THE THREE PROJECT AREAS YOU HAVE VISITED

Wilder	Bellows Falls	Vernon
Winter (Dec-Mar)	Winter (Dec-Mar)	Winter (Dec-Mar)
Spring (Apr-May)	Spring (Apr-May)	Spring (Apr-May)
Summer (Jun-Sept)	Summer (Jun-Sept)	Summer (Jun-Sept)
Fall (Oct-Nov)	Fall (Oct-Nov)	Fall (Oct-Nov)

7. Typically, what was the average number of people in the group that participated in outdoor recreation activities at Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream with you or members of your household during the past year (Labor Day 2013 through Labor Day 2014)? *FILL IN THE BLANK*

__________ Adults ___________Children (under 16 years)

8. Select **ALL** outdoor activities, for each season, that you or members of your household participated in at Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream during the past year (Labor Day 2013 through Labor Day 2014)?

CHECK ALL APPLICABLE BOXES FOR THE LISTS BELOW

ACTIVITY	**Summer** (Jun, Jul, Aug)	**Fall** (Sept, Oct, Nov)	**Winter** (Dec, Jan, Feb)	**Spring** (Mar, Apr, May)
ON THE WATER				
Motor boating (not fishing)				
Fishing from boat/ice fishing				
Water skiing/tubing				
Jet skiing/Personal watercraft use				
Canoeing/kayaking – flat water				
Canoeing/kayaking - whitewater				
Multi-day float trip				
Sailing				
Sculling				
Swimming/sunbathing from a boat				
Tubing				
Snowmobiling				
Cross-country skiing/snow shoeing				
ON SHORE				
Fishing from shore				
Wildlife viewing/birding				
Sightseeing/driving for pleasure				
Picnicking/family gathering				
Hunting				
Tent/vehicle camping				
Bicycling/mountain biking				
Walking/hiking				
Swimming/sunbathing from shore				
Other:				

9. Please rate your overall level of satisfaction with the <u>number</u> of Public Recreation Areas at

Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream that you or members of your household used over the past year.

CHECK ONE NUMBER FOR EACH RESERVOIR AND RIVERINE SECTION

Wilder

Location	Extremely satisfied		Moderately satisfied		Neutral		Slightly satisfied		Not at all satisfied
Reservoir	1	2	3	4	5	6	7	8	9
Downstream	1	2	3	4	5	6	7	8	9

Bellows Falls

Location	Extremely satisfied		Moderately satisfied		Neutral		Slightly satisfied		Not at all satisfied
Reservoir	1	2	3	4	5	6	7	8	9
Downstream	1	2	3	4	5	6	7	8	9

Vernon

Location	Extremely satisfied		Moderately satisfied		Neutral		Slightly satisfied		Not at all satisfied
Reservoir	1	2	3	4	5	6	7	8	9
Downstream	1	2	3	4	5	6	7	8	9

10. Please rate your overall level of satisfaction with the type of Public Recreation Areas at Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream that you or members of your household, used over the past year.

CHECK ONE NUMBER FOR EACH RESERVOIR AND RIVERINE SECTION

Wilder

Location	Extremely satisfied		Moderately satisfied		Neutral		Slightly satisfied		Not at all satisfied
Reservoir	1	2	3	4	5	6	7	8	9
Downstream	1	2	3	4	5	6	7	8	9

Bellows Falls

Location	Extremely satisfied		Moderately satisfied		Neutral		Slightly satisfied		Not at all satisfied
Reservoir	1	2	3	4	5	6	7	8	9
Downstream	1	2	3	4	5	6	7	8	9

Vernon

Location	Extremely satisfied		Moderately satisfied		Neutral		Slightly satisfied		Not at all satisfied
Reservoir	1	2	3	4	5	6	7	8	9
Downstream	1	2	3	4	5	6	7	8	9

11. Please rate your overall level of satisfaction with the <u>location</u> of Public Recreation Areas at Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream that you or members of your household used over the past year.

CHECK ONE NUMBER FOR EACH RESERVOIR AND RIVERINE SECTION

Wilder

Location	Extremely satisfied		Moderately satisfied		Neutral		Slightly satisfied		Not at all satisfied
Reservoir	1	2	3	4	5	6	7	8	9
Downstream	1	2	3	4	5	6	7	8	9

Bellows Falls

Location	Extremely satisfied		Moderately satisfied		Neutral		Slightly satisfied		Not at all satisfied
Reservoir	1	2	3	4	5	6	7	8	9
Downstream	1	2	3	4	5	6	7	8	9

Vernon

Location	Extremely satisfied		Moderately satisfied		Neutral		Slightly satisfied		Not at all satisfied
Reservoir	1	2	3	4	5	6	7	8	9
Downstream	1	2	3	4	5	6	7	8	9

12. Please tell us what types of recreation facilities you think are needed and at what specific location(s)? *FILL IN THE BLANKS*

Type: ____

Location(s): ____

Type: ____

Location(s): ____

Type: ____

Location(s): ____

13. Have fluctuating water levels either at Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream ever affected your recreation experience?

YES *CONTINUE*

NO *SKIP TO SECTION 2*

14. What type of fluctuation affected your experience? (check one)

Rising

Lowering

Both

15. Briefly explain how the fluctuation you are thinking of positively or negatively affected your recreation experience?

____

16. In general, would you prefer fluctuations that were higher, lower, or about the same (check one)?

a. much lower fluctuations

b. slightly lower fluctuations

c. about the same; current situation is appropriate for my uses

d. slightly higher fluctuations

e. much higher fluctuations

17. Prior to visiting the Connecticut River, do you check public flow information (e.g., USGS website, American Whitewater website, or other sources) or the TransCanada flow phone?

a. Yes

b. No

c. Didn't know these resources existed

SECTION 2 Recreation Use Outside of Connecticut River Hydro Projects a.k.a ALTERNATIVE RECREATION AREAS

This section contains questions about how you or members of your household typically recreated at ALTERNATIVE RECREATION AREAS NOT at Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream during the past year, from Labor Day 2013 through Labor Day 2014. If you don't recall an answer exactly, please give us your best estimate.

18. Did you or members of your household visit ***ALTERNATIVE RECREATION AREAS*** within a day's drive from the Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream to recreate during the past year?

CHECK ONE

a. _________Yes b. ________No *SKIP TO SECTION 3*

19. Please list ***ALTERNATIVE RECREATION AREAS*** within a day's drive from the Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream where you or members of your household traveled to recreate during the past year? *FILL IN THE BLANKS*

a.____ State_________

b.____ State_________

c.____ State_________

d.____ State_________

e.____ State_________

f.____ State_________

20. What was the average number of people in the group that participated in recreation activities during the past year at ***ALTERNATIVE RECREATION AREAS*** (NOT WILDER, BELLOWS FALLS, OR VERNON RESERVOIRS OR IMMEDIATELY DOWNSTREAM)?

FILL IN THE BLANK

________________________ Adults_____________ Children (under 18 years)

21. During which season(s) did you or members of your household recreate the most at ***ALTERNATIVE RECREATION AREAS*** (NOT WILDER, BELLOWS FALLS, OR VERNON RESERVOIRS OR IMMEDIATELY DOWNSTREAM) during the past year?

CHECK ALL THAT APPLY

a. _____Winter (Dec-Mar) b. _____Spring (Apr-May)

c. _____Summer (Jun-Sept) d. _____Fall (Oct-Nov)

22. What outdoor activities did you or members of your household participate in at ***ALTERNATIVE RECREATION AREAS (***NOT at WILDER, BELLOWS FALLS, OR VERNON RESERVOIRS OR IMMEDIATELY DOWNSTREAM) during the past year (Labor Day 2013 through Labor Day 2014)?

PLEASE CHECK **ALL** APPLICABLE BOXES FOR THE LISTS BELOW.

ACTIVITY	**Summer** (Jun, Jul, Aug)	**Fall** (Sept, Oct, Nov)	**Winter** (Dec, Jan, Feb)	**Spring** (Mar, Apr, May)
ON THE WATER				
Motor boating (not fishing)				
Fishing from boat/ice fishing				
Water skiing/tubing				
Jet skiing/personal watercraft use				
Canoeing/kayaking – flat water				
Canoeing/kayaking - whitewater				
Multi-day float trip				
Sailing				
Sculling				
Swimming/sunbathing from a boat				
Tubing				
Snowmobiling				
Cross-country skiing/snow shoeing				
ON SHORE				
Fishing from shore				
Wildlife viewing/birding				
Sightseeing/driving for pleasure				
Picnicking/family gathering				
Hunting				
Tent/vehicle camping				
Bicycling/mountain biking				
Walking/hiking				
Swimming/sunbathing from shore				
Other:				

23. How many calendar days during the past year (Labor Day 2013 through Labor Day 2014) did you or members of your household participate in outdoor recreation activities at ***ALTERNATIVE RECREATION AREAS (***NOT AT WILDER, BELLOWS FALLS, OR VERNON RESERVOIRS OR IMMEDIATELY DOWNSTREAM)?

NUMBER OF CALENDAR DAYS_____________(Estimate if needed)

SECTION 3 – ALL RESPONDENTS

This section contains questions about your background that will help us compare your responses to those of other people. All of your answers are strictly confidential.

24. Are you a member of any of the following groups? *CHECK ALL THAT APPLY*

1 Adjacent landowner
2 Appalachian Mountain Club
3 Ledyard Canoe Club
4 American Whitewater
5 New England FLOW
6 The Nature Conservancy
7 Trout Unlimited
8 Ducks Unlimited
9 Vermont Rivers Conservancy
10 Connecticut River Joint Commissions
11 Connecticut River Watershed Council
12 Upper Valley Trails Alliance
13 Upper Valley Land Trust
14 Audubon Society
15 Bass Fishing Club
16 Other(s):________________________
X No, I am not a member of any of the above groups

25. Please select your gender, age, and race.

a. Male

b. Female

Age	Race
18 – 24	White
25 – 34	African American
35 – 44	Hispanic or Latino
45 – 54	Asian
55 – 59	American Indian or Alaskan Native
60 – 64	Native Hawaiian and Pacific Islander
65 – 74	Other:
75 – 84	Decline to answer
85 and over	
Decline to answer	

THANK YOU FOR YOUR TIME.

REVISED STUDY 31

WHITEWATER BOATING FLOW ASSESSMENT BELLOWS FALLS AND SUMNER FALLS

STUDY REQUESTS

FERC-11; NPS-02a, -02b; AMC-VRC-FRs-02; NEF-AW-AMC-03

STUDY GOALS AND OBJECTIVES

Public comments during scoping meetings and study requests received from FERC, NPS, AMC-VRC-FRs, and NEF-AW-AMC indicate a strong public interest in evaluating the suitability of whitewater boating opportunities in the bypassed reach below Bellows Falls dam and studying the effects of operations of the Wilder Project on paddling opportunities at Sumner Falls.

The goal of this whitewater flow study is to assess the presence, quality, access, flow information, and flow ratings for paddling opportunities in a stepwise manner.

The objectives of the study are to:

- identify recreational paddling opportunities at Sumner Falls and the suitability of the Bellows Falls bypassed reach for whitewater boating;
- describe flow-quality relationships at each location and identify acceptable and optimal ranges for each; information will be organized independently for Sumner Falls and Bellows Falls bypassed reach;
- describe potential effects of operations on paddling at each location and identify boater's sensitivity to current operations regimes (e.g., project discharges ranging from minimum flow to full generation);
- broadly characterize recreational paddling-relevant hydrology of the existing operating regime and qualitatively describe the relationship between paddling opportunities and project operations;
- characterize the potential for whitewater boating in Bellows Falls bypassed reach within the context of regional opportunities and those provided through current operation;
- determine the potential number of days flows for whitewater boating are available under the projects' current operations at both locations;
- identify resource needs (e.g., aquatic habitat) and competing recreational uses (e.g., canoeing or fishing) that are or will be affected by flows suitable for whitewater boating;
- identify all safety issues associated with whitewater boating and further development of opportunities for such at both locations;

- identify public access obstacles at Sumner Falls and Bellows Falls bypassed reach; and
- characterize effects on current project operations associated with providing various flows for recreational paddling.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In its study request, NPS identified the following resource management goals related to this study.

NPS	• The Connecticut River has been designated a National Blueway, part of the America's Great Outdoors Initiative. Among the stated goals are "to advance a whole-river, water-based approach to conservation, outdoor recreation, education, and sustainable economic opportunities in the watersheds in which we live, work, and play."

Also as included in the project PADs, the states of New Hampshire and Vermont have published Statewide Comprehensive Outdoor Recreation Plans (New Hampshire OEP, 2007; Vermont Department of Forests, Parks and Recreation, 2005), which provide goals recreation resource management for each state.

ASSOCIATION WITH OTHER STUDIES

Study results from this effort will help characterize the whitewater boating opportunities; however, conducting the study and interpreting the results will need to be done in a comprehensive manner. Results from other studies will help provide the context in which to assess the results of this study to properly balance the resource needs. Similarly, the study can be coordinated with other studies to achieve efficiencies associated with mobilized staff and operational requirements and so that study components are implemented in a stepwise manner to identify and avoid potential conflicts with resource (i.e., aquatic, aesthetic, and potential recreation) needs.

Sumner Falls

TransCanada conducted investigations into the federally listed Jesup's milk vetch (*Astragalus robbinsii* var *jesupii*) (Normandeau, 2013), which resulted in the development of stage-flow relationships in the reach below Wilder dam to assess the relationship between flows and Jesup's milk vetch. The area surrounding Sumner Falls also serves as critical habitat for state-listed cobblestone tiger beetle (*Cicindela marginipennis*), which will be studied in Study 26.

This The Sumner Falls location will also be studied in further detail under the Instream Flow Study (Study 9) with analysis of minimum and operational flows related to various aquatic habitats. Results from the Hydraulic Modeling (Study 4) and Operations Modeling (Study 5) studies will contribute to the understanding of the potential effects on operations of whitewater flows. Sumner Falls access, uses, and user interviews (among other data) will be documented with the Recreation Facility Inventory and Use &Needs Assessment (Study 30). This information will help characterize the social and human dimensions related to recreational use of the site to provide a richer context for understanding the relationship between the Wilder Project and natural and recreational resources.

Bellows Falls Bypassed Reach

Similar to the Sumner Falls section above, results from this study will provide information regarding the comprehensive understanding of the relationships between operations and natural, recreation, and aesthetic resources. Results from the Instream Flow Study (Study 9) will help describe the relationship between flow and habitat. Flow effects from operations will also be assessed through the Hydraulic Modeling Study (Study 4) and Operations Modeling Study (Study 5). The American Eel Upstream Passage Assessment (Study 18) will provide insight into eel passage needs and flow relationships.

This study will also draw upon the documentation of the bypassed reach described in the Recreation Facility Inventory, Use & Needs Study (Study 30) (e.g., gradient, access, and length). This study depends on controlled releases from the Wilder Project and from Bellows Falls dam into the Bellows Falls bypassed reach, and the timing and magnitude of those releases could be scheduled to accommodate various studies. Controlled flows provided for the Instream Flow Habitat Study (Study 9) could be used in lieu of separate flows for this study. Study 9 will also produce hydraulic modeling (2-D) outputs that could provide additional information about flows (e.g., depths, water velocity, and direction) and be used to supplement this study. The Bellows Falls Aesthetic Flow Study (Study 32) is similarly dependent on controlled flows and will most likely be coordinated around scheduled releases.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

The Bellows Falls PAD does not include information on the suitability of boating in the bypassed reach because that is not part of the project's current operation. Currently, there is no reasonably available information on the characteristics or boating suitability of the Bellows Falls bypassed reach or the range of boatable flows. Furthermore, no information is available to analyze whether flows could be provided to enhance whitewater boating opportunities in the bypassed reach.

In terms of the physical capability to release water into Bellows Falls bypassed reach, the PAD indicates that no minimum flow is required in the bypassed reach under the current project license, and the amount of spillage and leakage through dam gates determines the amount of flow present. When flows exceed project capacity, the excess water is spilled into the bypassed reach through two 115-foot-long roller gates that discharge water 15 to 18 feet below the impoundment surface. Flows through the flashboard section of the dam occur when inflows exceed roller gate capacities combined with generator discharge (approximately 40,000 cfs). The minimum sustained gate opening for these roller gates is 1 foot to prevent river debris from damaging the submerged seals or getting lodged and preventing the closure of the gate. Considering the overall 3-foot range of operation of the impoundment, a 1-foot opening discharges 3,000 to 3,300 cfs into the bypassed reach.

There have been historical instances of personal injury and accidents, including at least one fatality, due to public use or attempts at boating spill-related flows in the Bellows Falls bypassed reach. This level of danger requires that safety considerations be a key component of the study and demonstration flows. The safety considerations will be identified and applied to the demonstration flows if evaluators require onsite presence in the bypassed reach itself and to evaluation of any potential future whitewater boating requirements for flow in the bypassed reach.

The Wilder PAD recognizes Sumner Falls (also known as Hartland Rapid) for its whitewater characteristics and summarizes some basic information about the site; however, the PAD does not include information about the relationship between flow releases from Wilder and the characteristics, boating suitability, or other flow-dependent recreation effects of those releases.

Existing Wilder and Bellows Falls operations data can provide baseline information about opportunities for boating and flow-dependent recreation under current operations.

PROJECT NEXUS

Operation of the Wilder Project regulates the level of flow downstream of the dam. Because the timing, duration, and magnitude of these flow releases can affect recreational paddling opportunities at Sumner Falls, a better understanding of operations and recreational paddling opportunities for this location is needed.

Bellows Falls Project operation diverts flows from the bypassed reach of the Connecticut River that could, in theory, provide whitewater boating opportunities. Other than leakage from the dam, flows into the bypassed reach only occur during high-flow events when inflow exceeds station capacity and the excess is spilled at the dam. An analysis of project operations relative to a range of boatable flows will help form the basis for assessing how often boatable flows occur in the bypassed reach under existing conditions and the quality of those flows.

STUDY AREA AND STUDY SITES

This study focuses on two specific locations: Sumner Falls, which is downstream of the Wilder Project but is affected by project discharge, and the Bellows Falls bypassed reach directly downstream of Bellows Falls dam. Sumner Falls is a series of ledges sprawled across a wide section of the Connecticut River about 7 miles downstream of Wilder dam, creating a quarter mile stretch of rapids as the river drops 7 vertical feet. The Bellows Falls bypassed reach is a natural river bed approximately 3,500 feet long that receives minimal flow from dam leakage, high-flow events, and dam releases during powerhouse outages.

METHODS

The methods used in this study are designed to gather information to assess flow ranges for recreational paddling in a stepwise, or phased, manner. Specific protocols related to study components will follow accepted practices outlined by Whittaker et al. (1993, 2005).

A phased approach will encourage advancing the level of effort needed to quantify specific opportunities and flow needs for a reach only if less intensive work is unable to provide that information. For example, whitewater boating already exists at Sumner Falls, but the relationship to Wilder Project operations and the quality of the recreational paddling is less well documented. A phased approach is even more important for Bellows Falls because it is currently unknown if the bypassed reach is suitable for whitewater boating. The basics of the reach and any insurmountable risks should be documented and assessed prior to committing to on-water flow reconnaissance or controlled flow evaluations.

Study phases will progress according to the levels prescribed by Whittaker et al. (2005). Study information acquisition will begin with Level 1 methods (a review of existing information and limited reconnaissance of river segments at a single flow) and will also include Level 2 (structured interviews with experienced recreation users for target opportunities and on-land boating feasibility assessment). Decisions about whether or not to proceed will be made at the conclusion of each level and work toward Level 3 methods (e.g., on-water, single-flow reconnaissance or multiple-flow, controlled-flow study). Taken together, this level of precision/study intensity is expected to provide sufficient quantification of flow ranges or flow fluctuation tolerances to assess broad project effects from current operations.

Review of Existing Documents (Level 1)

A review of relevant resource documents (e.g., guidebooks)and operational data will be an important first step in a flow assessment for recreation. This study component will include a directed assessment of existing project hydrology data and operational constraints relative to recreational paddling opportunities. These materials will help clarify existing or potential opportunities and flow issues to enable researchers to become familiar with operations and resulting recreation-relevant hydrology of the river reaches.

Existing available hydrology information will be used to generally describe the range of flows available in reaches during specified recreation seasons to provide a context for conducting field work, interviews, and controlled flow study components.

Resource Reconnaissance (Level 1)

Field work is planned for spring/summer 2014. This time frame will allow researchers to identify potential study participants and observe recreation opportunities at common flow levels (assuming normal conditions are available). It also will allow sufficient time to develop preliminary hydrology information, become familiar with the resource via interviews and review of existing information, and coordinate logistics with local recreational paddlers who may help guide during whitewater boating reconnaissance. Potential study participants will be experienced recreation users who will be identified by the study leads through networking. TransCanada's consultants will contact existing paddler groups, agencies, and stakeholders and will proactively seek out and contact individuals who use the river for recreation. Potential study participants will be interviewed and selected for further involvement through the Level 2 and potentially Level 3 assessments, pending the outcome of each step. Study participants will be selected based on their paddling experience, familiarity of the river, and representativeness of their boating type relative to the suitability of boating within the bypassed reach and Sumner Falls. Based on other similar FERC relicensing studies, potential study participants typically include American Whitewater members, guides, outfitters, and boaters who have many years of experience in whitewater boating and have taken many trips on a particular river. Other potential participants may include members of the public who have the experience described above and are well known to local resource agency staff.

Simultaneous with the efforts to characterize hydrology and build a study participant panel, TransCanada will work to identify feasible methods to control releases for study evaluation. The method for releasing flows and providing access into the bypassed reach is also important for informing a number of the other proposed studies, such as the Instream Flow Study (Study 9), Resident Fish Assemblage (Study 10), American Eel Upstream Passage Assessment (Study 18), and Bellows Falls Aesthetic Flow Study (Study 32).

Interviews and Land-Based Feasibility Assessment (Level 2)

Interviews with key resource experts or recreation users offer complementary information about recreational paddling and the system's hydrology. Interviews will be conducted with a minimum of two to four experienced recreation users (and/or agency staff) for each recreational paddling opportunity (e.g., canoe and various types of whitewater kayak).

Interviews will be semi-structured in that specific topics will be addressed, and questions will focus on how people boat at Sumner Falls and on characterizing the suitability of whitewater opportunities in the bypassed reach. The goal is to describe the character of the recreational paddling opportunities, identify flow-dependent attributes, and determine any insurmountable risks. A second series of questions will focus on the effects of flows on those attributes and whether interviewees can identify specific flows or fluctuation levels that affect the quality of opportunities (e.g., acceptable and optimal ranges and fluctuation tolerances). The interviews will also inform the land-based assessment of a single flow at the two study sites.

The land-based feasibility assessment will include visually evaluating Sumner Falls and the bypassed reach and having open discussion with interview participants related to the recreational paddling opportunities (and specifically the feasibility of boating within the bypassed reach), possible flow ranges, and potential risks and safety hazards. Land-based assessments will be compared with any pre-recorded video footage of flows in the bypassed reach to examine such factors as flow levels, access, safety, and hazards. The examination of these issues will assist in determining the suitable starting point or proposed range of flows for the whitewater boating assessment. Access will be evaluated prior to inviting study participants into the field to visually assess flows associated with this study level. Access on foot through the constriction near the fish barrier dam is unknown and is strongly influenced by flows. An initial whitewater rating will be identified by consensus of the participants in order to be sure the appropriate level of boating expertise is chosen for the controlled flow participants. Views from near the Villas Bridge (Key Observation Points 2 and 3 from the Bellows Falls Aesthetics Flow Study (Study 32) will provide information on access and safety considerations prior to the study participants entering the bypassed reach.

Results from the interviews and land-based assessments will be summarized and presented in an interim report. The results of the interim report and review of any pre-recorded video footage of flows in the bypassed reach will help inform the next steps, which may include the Level 3 on-water assessment(s) and the suitable starting point for examining appropriate flow levels or a proposed range of flows.

Controlled Flow Study (Level 3)

Sumner Falls

TransCanada will make three different sized flow releases from the Wilder Project to assess recreational paddling opportunities and rate the quality of the flows at Sumner Falls. Study participants will invite between 8 and 12 intermediate, advanced, and expert paddlers (depending upon the whitewater rating assigned in Level 2 assessments) to participate in a controlled flow study at Sumner Falls. Study participants will be selected through networking efforts similar to and derived from the Level 1 effort. In addition to selecting participants through networking initiated by the study leads, stakeholders and agencies can nominate intermediate to experienced paddlers to represent boaters who engage in the various paddling opportunities popular at Sumner Falls (e.g., canoe and play boating). Participants also can be selected from TransCanada community relations contact lists. Study leads will proactively coordinate with the boating community to identify and select the appropriate boaters for this portion of the study. The selection process will include interviewing all potential paddlers prior to finalizing the study participant list to ensure that all participants have the appropriate boating capabilities and experience level boating at Sumner Falls, a comprehensive understanding of the purposes of and their personal involvement in the study, and an understanding of what is expected from them while participating.

Participants will complete a pre-fieldwork interview on their experience and boating preferences, will be responsible for paddling Sumner Falls at each flow and assessing those flows, and will participate in a focus group after each flow. After all flows have been assessed, participants will provide their overall evaluations using a “flow comparison” format. Attachment 31-A presents the proposed questionnaire for paddlers participating in the Sumner Falls controlled flow study. Photographs and video footage will be taken to show whitewater boater and canoers in key rapids, pools, or other features and conditions, providing useful documentation, particularly in combination with qualitative focus group notes, quantitative data from surveys, and relevant hydraulic modeling outputs.

Bellows Falls Bypassed Reach

If whitewater boating is deemed feasible and safe in the Bellows Falls bypassed reach after the on-land assessment described for Level 2, between two and four expert boaters will be invited to boat a single flow in the reach and respond to predetermined rating questionnaires. The actual questions will be similar to those developed for Sumner Falls (see Attachment 31-A) but will be finalized after the Level 2 assessment. Whittaker (2005) notes that on-water, single-flow boating assessments may be a planned interim step when a controlled flow study is recommended and that when this occurs, fewer participants and a professional judgment-level analysis may be sufficient (rather than conducting formalized evaluations) and minimize costs. Potential boaters will be identified similar to the panel for Sumner Falls.

Experienced boaters will participate in a single-flow reconnaissance trip to better understand the whitewater characteristics within the reach. Photographs and video footage will be collected to document the trip. After the trip, a focus group discussion will be used to summarize opinions about the suitability of boating, types of opportunities, possible flow ranges, or insurmountable hazards associated with the bypassed reach.

If the single trip is successful and more information is required to quantify acceptable and optimal flow ranges, types of boats, and potential trips, multiple boat trips will be made either as stand-alone study releases or in coordination with controlled flows scheduled for the Instream Flow Study (Study 9). This portion of the study will commence based on the proceeding efforts. During this step, 8 to 12 expert whitewater boaters will paddle the river at up to three controlled releases with final flow releases, required boater experience, and boater numbers to be developed in consultation with the paddlers and TransCanada after integrating results from Levels 1 and 2. After all flows have been boated, participants will provide their overall evaluations in a “flow comparison” format using a form similar to the one currently developed for Sumner Falls. Development of the survey tool for a Bellows Falls multiple-flow assessment is premature at this point because of the lack of certainty about: 1) how TransCanada will make the controlled releases; 2) the flexibility TransCanada will have in controlling the magnitude of those releases; 3) the extent of boater safety issues; and 4) the types of issues that will be important to expert boaters. Hydrological flow modeling (2-D) conducted as part of that study could be used to show current direction, water velocity, and depth patterns in the bypassed reach and linked with boater criteria or observational data as a supplement to the qualitative approaches.

ANALYSIS

Results from each level of the stepwise approach will be documented and will inform the process as the study progresses. Results from the literature review and field-based reconnaissance will be used to determine whether, and at what flow, a single reconnaissance flow trip should be made in the bypassed reach. Successful completion of a single-flow trip will provide information about the flow levels and types of watercraft appropriate for a multiple–flow, controlled-flow study. Similarly, results from interviews and observations at Sumner Falls will help to identify the flows needed for the multiple-flow assessments. Quantitative ratings will be made for whitewater boating opportunities and conditions. Results will incorporate hydrology, project operations, interview results, and quantitative data collected from the rating forms (questionnaires) completed by study participants. An overall flow preference curve for paddlers will be provided.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methods used in this study are consistent with professional practice. The overall approach is commonly used in FERC relicensing proceedings and is consistent with generally accepted methods used by federal and state agencies for conducting recreational flow assessments. In addition, the methods for the study are consistent with FERC study requirements under the ILP.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. The report will 1) describe the whitewater boating attributes of the range of flows examined, including level of difficulty, play spots, safety issues, and portage requirements; 2) identify the acceptable and optimal flows for the reach and the frequency of availability of the identified flows under current project operations; and 3) incorporate relevant results from the Recreation Facility Inventory, Use & Needs Assessment (Study 30), including characterization of the access or suitability of the bypassed reach for whitewater boating (e.g., gradient, length, and character of potential).

A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This will be a 1-year study conducted during the first study year (2014). Desktop and pre-field work will begin in late 2013 after FERC's approval of the study plan. This is a flow study for which the methods for making controlled releases and the magnitude of those releases have not yet been fully developed. The process could be coordinated to occur with spring run-off spill events, which will as early learning sessions to observe spills in the bypassed reach. Once the mechanics of making releases have been determined, this study will likely rely on distinct controlled releases or those provided for the Instream Flow Assessment (Study 9). Controlled flows may be required over the course of 3 to 4 consecutive days, during which multiple-flow, on-water trips will be made.

LEVEL OF EFFORT AND COST

The estimated budget for the study is approximately $90,000.

REFERENCES

New Hampshire OEP (Office of Energy and Planning). 2007. New Hampshire Statewide Comprehensive Outdoor Recreation Plan (SCORP): 2008–2013. Concord, NH. December 2007.

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ATTACHMENT 31-A: BOATER SURVEY

Sumner Falls (Hartland Rapids) Boating Study

Date: ____/ ____/ 2014 Flow: _____ cfs Your name: ______________________________

Section A: General

1. How many years have you been taking trips to this location? _________________years

2. Are you an outfitter, guide, or private river user?
   1. Outfitter
   2. Guide
   3. Private User
   4. Other_________________

3. How would you rate your own skill level?
   1. Beginner (some previous boating experience)
   2. Intermediate
   3. Advanced
   4. Expert

4. Do flow levels influence whether or not you take a trip?
   1. Yes
   2. No

5. Do flow levels influence ***how*** you take trips (when you go, what craft you use, which rapid you run, how much gear you take, etc.)? If yes, please describe below.

____

____

Section B: Post-run Questions

1. What type of craft did you use for this run? *(Circle one)*
   Kayak: (hybrid · play boat · creek boat · river boat) Inflatable kayak Canoe Other: ___________

2. In general, what class (example: I–III+) was the whitewater difficulty at this flow? _

3. Did you have any significant problems (e.g., had to swim, pinned, or wrapped a boat) during your run? Please provide a brief description and location of any incident (continue on back if needed).

4. Please evaluate the flow on this trip for your craft and skill level for each of the following characteristics. *(Circle one number for each item).*

	Totally Unacceptable			Marginal			Totally Acceptable
Boatability	1	2	3	4	5	6	7
Availability of technical rapids	1	2	3	4	5	6	7
Availability of powerful hydraulics	1	2	3	4	5	6	7
Availability of play boating areas	1	2	3	4	5	6	7
Overall whitewater challenge	1	2	3	4	5	6	7
Safety (due to flow levels)	1	2	3	4	5	6	7
Hazards present in river							
Aesthetics of river/channel	1	2	3	4	5	6	7
Overall Rating	1	2	3	4	5	6	7

5. In general, would you prefer a flow that was higher, lower, or about the same as this flow? *(Circle one).*
   1. Much lower flow
   2. Slightly lower flow
   3. About the same; this was close to an optimum flow
   4. Slightly higher flow
   5. Much higher flow

6. What is the minimum skill level necessary to successfully run this segment at this flow level?
   1. Novice (no previous boating experience)
   2. Beginner (some previous boating experience)
   3. Intermediate
   4. Advanced
   5. Expert

7. If this flow were provided periodically, are you likely to return for future boating? *(Circle one).*
   1. Definitely no
   2. Possibly
   3. Probably
   4. Definitely yes

Section C: Close-out Questions

1. Compared to other ***play spots***, how would you rate the boating opportunity at this location (assume optimal flows). *(Circle one number for each; if you are unsure about a comparison, leave that item blank).*

Compared to…	This reach is… Worse than average	Below average	Average	Above average	Much better than average
…other rivers within 2 hours of Sumner Falls (Hartland Rapid)	1	2	3	4	5
…other rivers in New England	1	2	3	4	5

2. Compared to other ***reaches***, how would you rate the boating opportunity at this location (assume optimal flows). *(Circle one number for each; if you are unsure about a comparison, leave that item blank).*

Compared to…	This reach is… Worse than average	Below average	Average	Above average	Much better than average
…other rivers within 2 hours of Sumner Falls (Hartland Rapid)	1	2	3	4	5
…other rivers in New England	1	2	3	4	5

3. Please provide overall evaluations for the reach for the following flows for your craft and skill level. Please consider all the flow-dependent characteristics that contribute to high quality trips (e.g., boatability, whitewater challenge, safety, availability of surfing or other play areas, and aesthetics).*(If you do not feel comfortable evaluating a flow you have not seen, don't circle a number for that flow).*

Sumner Falls	Totally Unacceptable			Marginal			Totally Acceptable
700	1	2	3	4	5	6	7
1000	1	2	3	4	5	6	7
1700	1	2	3	4	5	6	7
2000	1	2	3	4	5	6	7
2700	1	2	3	4	5	6	7
3500	1	2	3	4	5	6	7
5500	1	2	3	4	5	6	7
7000	1	2	3	4	5	6	7
9000	1	2	3	4	5	6	7
11000	1	2	3	4	5	6	7

4. Please specify the flows that you think would provide the following types of experiences on the reach.
(Note: It's okay to specify flows you have not observed, but which you think would provide the type of experience specified).

	Flow in cfs
What is the highest water level that a through canoe boater would run (above this they would portage)? Note: a through canoe boater is considered someone making a downriver trip and may be packing provisions and gear for overnight stays along the river and not visiting the rapids solely to boat the Sumner Falls.	
Some people are interested in a "technical" experience at lower flows. Think of this "technical" experience in your craft.	
What is the lowest flow that provides an acceptable experience at this location?	
What is the best or optimal range of flows for a technical experience at this location?	________to________
Some people are interested in taking trips at somewhat higher flows that have stronger hydraulics but may offer less technical routes through rapids. Think of this "standard trip" in your craft.	
What is the lowest flow that provides an acceptable experience for a standard trip at this location?	
What is the best or optimal range of flows for this type of use at this location?	________to________
Some people are interested in taking trips at much higher flows that have more powerful hydraulics and larger waves. Think of this as "big water use" in your craft.	
What is the lowest flow that provides an acceptable experience for a "big water" type of trip?	
What is the best or optimal range of flows for this type of trip?	________to________
What is the highest safe flow for your craft and skill level?	
If TransCanada were to provide a boating release, what flow would you prefer	

5. Some people are interested, or even prefer, variability in the amount of flow they boat play spots during different visits. Please rate your preference for variability in flows (flows of different magnitude) between trips to this particular location:

	Totally Unacceptable			Marginal			Totally Acceptable
Variability	1	2	3	4	5	6	7

6. Between what level of flow (min and max) would you prefer if there was structured variability in the amount of flow in Sumner Falls (e.g., between xxx and yyy cfs): ________and _________.

REVISED STUDY 32

BELLOWS FALLS AESTHETIC FLOW STUDY

RELEVANT STUDY REQUESTS

VANR-34; ROCK-05

STUDY GOALS AND OBJECTIVES

In their study requests, VANR and the Rockingham Conservation Commission indicate a need to characterize the aesthetic attributes of the Bellows Falls bypassed reach.

The goals of this study are to:

- characterize the aesthetic conditions in the bypassed reach at various levels of flows; and
- provide a range of aesthetic ratings that can be used to assess conditions relative to Vermont's water quality standards.

The primary objectives of this study are to:

- collect videography and still photography to document the appearance of the bypassed reach under various existing and controlled flows conditions;
- identify populations potentially affected by the aesthetic conditions in the bypassed reach, and determine how the interests of these populations relate to the aesthetic conditions;
- identify flow ratings and timing preferences across the full range of potential user groups; and
- estimate the costs to provide different levels of flow and assess the trade-offs of the various flows among different populations.

RELEVANT RESOURCE MANAGEMENT GOALS

In its study request, VANR described jurisdictional resource management goals for this study, as summarized below.

VANR	• State water quality standards for designated uses of Class B waters relative to aesthetic values including water character, flows, water level, and bed and channel characteristics.

The Bellows Falls bypassed reach is located primarily in New Hampshire. New Hampshire water quality standards do not include aesthetics as a parameter for Class B waters.

ASSOCIATION WITH OTHER STUDIES

This study requires observations of specific, measured flow releases into the bypassed reach for rating by study participants. Similarly, ranges of controlled flows may also require a level of observation as a component of the Instream Flow Study (Study 9) and the Whitewater Boating Flow Assessment (Study 31). At this time it is unclear how and what level demonstration flows would be necessary in those studies to meet those study objectives. If it is feasible, and to the extent practicable, elements of this aesthetic flow assessment analysis will be incorporated into the range of flows associated with those studies.

Furthermore, there may be preliminary, non-flow assessment criteria and information that is required to determine what, if any, flows are suitable for those interests. TransCanada is investigating the mechanics of making controlled releases to the bypassed reach. All of those study determinations should be completed before conducting a series of controlled flows specifically to address this study's aesthetic analysis. Alternatively, a series of controlled releases could be attempted solely for this study if either Study 9 or Study 31 flow demonstrations not prove feasible or adequate to meet this study's objectives. To the extent possible, aesthetic evaluations could also include naturally occurring spill events.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

No information is available to characterize the aesthetic conditions in the Bellows Falls bypassed reach. No minimum flow is required in the bypassed reach, and the amount of flow present depends on the amount of spillage and leakage from the dam. When flows exceed project capacity, the excess water is spilled into the bypassed reach through two, 115-foot-long roller gates that discharge water 15 to 18 feet below the impoundment surface. Flows over the stationary flashboards would occur when inflows exceed roller gate capacities combined with generator discharge (approximately 40,000 cfs). The minimum gate opening for these gates is 1 foot to prevent river debris from damaging the submerged seals or getting lodged and preventing gate closure. Considering the overall 3-foot range of operation of the impoundment, a 1-foot opening discharges 3,000 to 3,300 cfs into the bypassed reach.

PROJECT NEXUS

Lack of consistent flow passing the dam and into the bypassed reach directly affects aesthetic resources associated with the dam and the bypassed reach itself. VANR requests a study of alternative flows released from Bellows Falls dam. This information will be needed to characterize existing and potential aesthetic conditions before VANR can determine whether the project would meet Vermont water quality standards.

STUDY AREA AND STUDY SITES

The study area includes the Bellows Falls bypassed reach from the base of the dam to a point below the fish barrier dam at the confluence with the tailrace. The fish barrier dam will be considered an element associated with the bypassed reach for the purposes of this study. The bypassed reach will be assessed from publicly accessible and representative observation points under different flow conditions. Review of site conditions suggests direct views into the bypassed reach are very limited. Figure 32-1 shows the public, key observation points (KOPs), which include (from upstream to downstream): KOP-1: Arch Bridge, from the sidewalk looking over the dam into the bypassed reach[4]; KOP-2: along New Hampshire Route 12 (River Street or Main Street); KOP-3: the now-closed Vilas Bridge (Bridge Street)[5]; and KOP-4: from the access road downstream of the fish barrier dam on the Vermont shore overlooking the downstream portion of the bypassed reach. If additional field investigation reveals that any of these sites are inadequate for viewing, alternative publically accessible viewing points will be sought, in consultation with the working group.

METHODS

Bypassed reach conditions during a range of flow releases will be recorded (digital videography and photographs) and rated using the comparative method. Photos and videos of demonstration flows or controlled releases scheduled as part of the Instream Flow Study (Study 9) or the Whitewater Boating Flow Assessment (Study 31) will be recorded and edited for use in this study.

The Bellows Falls Project is a central feature to the villages of Bellows Falls, Vermont, and North Walpole, New Hampshire. To evaluate the scenic components of various flows at the local landscape level, study leads will organize between 10 and 12 residents, business owners, and employees in the local area to respond to survey questions in a focus group setting. Kruger (2008) recommends focus groups between 8 to 10 people, stating that a larger group will limit the detail of some responses because participants feel a pressure to share airtime with others and, conversely, participants in a smaller group may feel an uncomfortable pressure to talk more than they would otherwise to fill dead air. In study plan development discussions, FERC staff suggested considering including up to 16 participants in the focus group to ensure an appropriate cross section of the broader population.

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[4] Views into the bypassed reach from KOP 1 are limited to pedestrians because the concrete barrier of the bridge and the train trestle over the dam severely limit views into the reach from vehicles driving across the bridge. A final decision to include this KOP or a potential alternative KOP in the study will be made in consultation with the working group after assessing the views in the field.

[5] Concrete 'Jersey' barriers are in place to deter both vehicle and pedestrian access across the Vilas Bridge.

Figure 32-1. Locations of key observation points for Bellows Falls aesthetic flow study.

Given the relatively small populations in the two towns and the lack of clear sight lines into the bypassed reach, 10 to 12 participants strikes an appropriate balance between Kruger's recommendation (8 to 10 participants) and FERC suggestions (16 participants). The four KOPs represent the only public locations where people can view the bypassed reach during the leaf-on season, and one of these is on a closed bridge. During leaf-off conditions, sight lines into the bypassed reach from Route 12 would likely improve; however, the views would continue to be obstructed by the remaining tree branches, evergreens, residential structures, and further obstructions associated with viewing while driving along the road (e.g., short view times, lack of concentration due to requirements of driving).

Out-of-area-resident participation in the focus groups were dismissed for the following reasons: 1) two of the KOPs are from the perspective of pedestrians (both bridges), and it is unlikely that many out-of-area visitors would walk across either bridge when visiting the area because the bridges do not connect two commercial centers; 2) sight lines from Route 12 are very poor with only a few seconds of viewing opportunity into the bypassed reach from a moving vehicle due to the dense vegetation during leaf-on conditions, and private residences along the eastern side of the reach limit all opportunities to view the bypassed reach; and 3) personal preferences of flow aesthetics are subjective, and there is no basis to believe out-of area visitor subjectivity is any different than that of the local population.

TransCanada Community Relations , VANR, and Rockingham Conservation Commission staff will provide initial contacts for potential study participants. These contacts can nominate additional or alternate participants. Potential participants will be screened for bias and must not be employed or related to an employee of TransCanada or have any preconceived notion regarding appropriate flow levels in the bypassed reach.

Study participants will convene at a single location to view a series of photos and videos of different levels of flow including existing conditions in the bypassed reach taken from the KOPs. Each participant will be asked to rate the conditions in the photos under the specified flow releases using a predefined rating form (included as Attachment 32-A). A seven-point Likert acceptability scale ranging from -3 ("totally unacceptable") to +3 ("totally acceptable") with a 0 midpoint ("neutral") will serve this purpose. Researchers have advocated the use of this type of metric for assessing recreation and aesthetic flows (Shelby et al., 1992; Whittaker et al., 1993, 2005). After the single flow assessments, participants will be asked to provide input comparing between flows. At a minimum, participants will complete a form to rate the leakage flow conditions and each of the controlled demonstration flows released in the bypassed reach. The actual flow in cfs will not be disclosed, and respondents will be asked to evaluate flows by demonstration flow number only. Representing different flows through photographic media provides an efficient way to avoid having users observe flows onsite (Whittaker et al., 2005).

TransCanada may photograph and videotape natural spill events from the KOPs prior to any demonstration releases to capture these natural events for possible use in this study. In theory, any pre-controlled release photography and video would capture a range of natural spill and seasonal conditions (e.g., early spring runoff, potential icing or misting) which would augment the photos and videos used to capture the controlled releases. TransCanada does not intend to conduct winter demonstrations for viewing of seasonal conditions (e.g., icing or misting) or dam safety.

ANALYSIS

Survey responses will be summarized, and results will be tallied to identify whether each assessed flow creates acceptable, neutral, or unacceptable conditions for the group. Survey responses will be assessed for trends associated with a particular user group and relationship to the Vermont Class B water quality management objectives pertaining to aesthetics. This information will be correlated with operational data to estimate the costs to provide different levels of flow.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methods for the study are consistent with professional practices. The overall approach is commonly used in FERC relicensing proceedings and is consistent with generally accepted methods used by federal and state agencies for conducting aesthetic flow assessments. Photographing and videotaping the bypassed reach when it contains each of the alternative flows and using these recordings to survey a group of individuals using the comparative method is an equivalent and efficient methodology to an onsite demonstration flow approach.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study and will include photos and short videos of the various flows assessed in the study. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the project. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

Timing for this 1-year study will depend on the associated study schedules. Background materials (e.g., photos and videos) will be prepared in advance of the evaluation phase. Because this is a flow-dependent study, the timing of field work to photograph and record flows in the bypassed channel depends on scheduled releases. At a minimum, the controlled flow releases to be provided for the associated flow studies (Studies 9 and 31) would be videotaped and photographed for use in this study. Evaluations of all flows will be done collectively after all associated demonstration flows have been recorded, anticipated to conclude by summer 2014.

LEVEL OF EFFORT AND COST

The estimated budget for the study is $40,000.

REFERENCES

Krueger, R.A. and M.A. Casey. 2008. Focus groups: A practical guide for applied research. 4th edition. New York: SAGE.

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ATTACHMENT 32-A: AESTHETIC SURVEY

Bellows Falls Bypassed Reach Aesthetics Flow Study

Date: _____ / _____/ 2014   Demo Flow: _______ cfs   Your name: ______________________

Section A: General

1. Which statement best represents your perspective? Today I am viewing the flows in the bypassed reach as: *CHECK ONE*
   - Bellows Falls/North Walpole Resident   *LIST TOWN*____________________
   - Area Resident   *LIST ZIP CODE*____________________
   - Bellows Falls/N. Walpole Business Owner or Employee
     *LIST BUSINESS TYPE AND LOCATION*_________________
   - Commuter   *TYPICAL TIME OF DAY PAST VIEWS OF THE BYPASSED REACH* ____________
   - Out-of-Area Visitor   *LIST ZIP CODE*______________________

2. How would you rate your familiarity with the Bellows Falls bypassed reach? *CHECK ONE*
   - Drive/walk by - see it frequently (time scale days between visits)
   - See it seasonally (time scale months between visits)
   - Few viewings (time scale years between viewings)
   - Rare viewings (time scale decades between viewings)
   - First time viewing

3. Considering your typical viewing of the bypassed reach, how long do you typically look at and consider the conditions within the bypassed reach during each viewing opportunity? ________________minutes/hours

4. What is the most common condition you observe while viewing the bypassed reach?
   - Spilling
   - Leakage flows (non-spill)

5. How important to you are the overall aesthetics of the Bellows Falls bypassed reach? *CHECK ONE NUMBER*

-3	-2	-1	0	1	2	3
Not at all important	Slightly important		Neutral	Moderately important		Extremely important

Section B: Key Observation Points and Flow Evaluations[6]

Key Observation Point 1 - Demo Flow #:___________________

6. Please evaluate the flow at this level for each of the following characteristics *(Check one number for each item).*

	Totally Unacceptable			Neutral			Totally Acceptable
Sound level	-3	-2	-1	0	1	2	3
Sound interest	-3	-2	-1	0	1	2	3
Amount of pools/still water in channel	-3	-2	-1	0	1	2	3
Amount of visibly moving water in channel	-3	-2	-1	0	1	2	3
Amount of exposed rocks/streambed in channel	-3	-2	-1	0	1	2	3
Contrast between pools and moving water	-3	-2	-1	0	1	2	3
Amount of water through/over dam	-3	-2	-1	0	1	2	3
Overall Aesthetic Rating	-3	-2	-1	0	1	2	3

7. In general, would you prefer a flow that was higher, lower, or about the same as this flow from this view? *(Check one).*
   - Much lower flow
   - Slightly lower flow
   - About the same; this was close to an optimum flow
   - Slightly higher flow
   - Much higher flow
   - Doesn't matter

8. List any positive attributes of this flow level (LIST SOME):

   ____

   ____

   ____

9. List any negative attributes of this flow level (LIST SOME):

   ____

   ____

   ____

Key Observation Point 2 - Demo Flow #:___________________

[6] This section would be repeated for each KOP at each release plus the existing leakage condition; to minimize redundancies and potential waste, individual sheets for each flow are not included here.

10. Please evaluate the flow at this level for each of the following characteristics *(Check one number for each item).*

	Totally Unacceptable			Neutral			Totally Acceptable
Sound level	-3	-2	-1	0	1	2	3
Sound interest	-3	-2	-1	0	1	2	3
Amount of pools/still water in channel	-3	-2	-1	0	1	2	3
Amount of visibly moving water in channel	-3	-2	-1	0	1	2	3
Amount of exposed rocks/streambed in channel	-3	-2	-1	0	1	2	3
Contrast between pools and moving water, hydraulic features or drops	-3	-2	-1	0	1	2	3
Flow over fish dam	-3	-2	-1	0	1	2	3
Overall Aesthetic Rating	-3	-2	-1	0	1	2	3

11. In general, would you prefer a flow that was higher, lower, or about the same as this flow from this view? *(Check one).*
    - Much lower flow
    - Slightly lower flow
    - About the same; this was close to an optimum flow
    - Slightly higher flow
    - Much higher flow
    - Doesn’t matter

12. List any positive attributes of this flow level (LIST SOME):

    ____
    ____
    ____

13. List any negative attributes of this flow level (LIST SOME):

    ____
    ____
    ____

-

Key Observation Point 3 - Demo Flow #:__________________

14. Please evaluate the flow at this level for each of the following characteristics *(Check one number for each item).*

	Totally Unacceptable			Neutral			Totally Acceptable
Sound level	-3	-2	-1	0	1	2	3
Sound interest	-3	-2	-1	0	1	2	3
Amount of pools/still water in channel	-3	-2	-1	0	1	2	3
Amount of visibly moving water in channel	-3	-2	-1	0	1	2	3
Amount of exposed rocks/streambed in channel	-3	-2	-1	0	1	2	3
Contrast between pools and moving water, hydraulic features or drops	-3	-2	-1	0	1	2	3
Flow over fish dam	-3	-2	-1	0	1	2	3
Overall Aesthetic Rating	-3	-2	-1	0	1	2	3

15. In general, would you prefer a flow that was higher, lower, or about the same as this flow from this view? *(Check one).*
    - Much lower flow
    - Slightly lower flow
    - About the same; this was close to an optimum flow
    - Slightly higher flow
    - Much higher flow
    - Doesn't matter

16. List any positive attributes of this flow level (LIST SOME):

____

____

____

17. List any negative attributes of this flow level (LIST SOME):

____

____

____

Key Observation Point 4 - Demo Flow #:___________________

18. Please evaluate the flow at this level for each of the following characteristics *(Check one number for each item).*

	Totally Unacceptable			Neutral			Totally Acceptable
Sound level	-3	-2	-1	0	1	2	3
Sound interest	-3	-2	-1	0	1	2	3
Amount of pools/still water in channel	-3	-2	-1	0	1	2	3
Amount of visibly moving water in channel	-3	-2	-1	0	1	2	3
Amount of exposed rocks/streambed in channel	-3	-2	-1	0	1	2	3
Contrast between pools and moving water, hydraulic features or drops	-3	-2	-1	0	1	2	3
	-3	-2	-1	0	1	2	3
Overall Aesthetic Rating	-3	-2	-1	0	1	2	3

19. In general, would you prefer a flow that was higher, lower, or about the same as this flow from this view? *(Check one).*
    - Much lower flow
    - Slightly lower flow
    - About the same; this was close to an optimum flow
    - Slightly higher flow
    - Much higher flow
    - Doesn’t matter

20. List any positive attributes of this flow level (LIST SOME):

____

____

____

21. List any negative attributes of this flow level (LIST SOME):

____

____

____

Section C: Comparative Flow Questions, after all demo flows have been viewed from all KOPs

22. At what flow level do the aesthetics or scenic quality of the bypassed reach decline?

    Demo Flow # ___________________

23. What flow level would you consider acceptable for a minimum aesthetic flow?

    Demo Flow # ___________________

24. What was your preferred flow condition?

    Demo Flow # ___________________

REVISED STUDY 33

CULTURAL AND HISTORIC RESOURCES STUDY

RELEVANT STUDY REQUESTS

FERC-12; VTSHPO-01, -02, -03; Nolumb-01; additional information requests from FERC, and comments from the New Hampshire Division of Historical Resources (NHDHR) (i.e., NHSHPO)

In their comments on the project PADs, FERC, VTSHPO, NHSHPO, and The Nolumbeka Project requested additional information about cultural resource studies that have been or will be conducted at the Vernon, Bellows Falls, and Wilder Projects as part of the overall FERC relicensing process. A meeting was held on June 7, 2013, with those and other interested parties to discuss the initial draft of the cultural resources study plan, and yielded clarification and additional information about those requests. Further clarification was provided through meetings with stakeholders, including the Narragansett Indian Tribal Preservation Office (NITHPO), VTSHPO, and NHSHPO, and comments provided by VTSHPO and Nolumbeka Project on the revised draft of this study plan which stakeholders filed with FERC by July 15, 2013.

STUDY GOALS AND OBJECTIVES

The overall goal of this cultural resource study is to assist FERC in complying with Section 106 of the National Historic Preservation Act (NHPA), as amended, and its implementing 36 C.F.R. § 800. The following were identified as the primary issues that the study plan for cultural resources must address:

- complete consultation to determine the Area of Potential Effects (APE) for the projects;

- gather information about cultural resources investigations that have been carried out to date, including Phase 1A archaeological surveys and historic architectural resource determinations of National Register of Historic Places (National Register) eligibility; and

- identify the methodology and schedule for carrying out investigations to complete the identification and evaluation of archaeological sites, historic architectural resources, and traditional cultural properties (TCPs) within the APEs.

The objectives are to define the APE for the projects; identify and evaluate historic properties, which are defined as buildings, sites, structures, objects, and TCPs that are listed or eligible for listing in the National Register (36 C.F.R. § 800.16(l)(1)), within the APE; assess the potential effects of the relicensing of the projects on historic properties pursuant to 36 C.F.R. § 800.5; and resolve any potential adverse effects through the development of Programmatic Agreements (PA) in accordance with 36 C.F.R. § 800.6. The work will be conducted within the framework of the

Section 106 process and will be carried out in close coordination with the consulting parties.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

The relevant resource management goal related to this study is to ensure the protection of cultural resources in compliance with Section 106 of the NHPA. The study will also comply with other relevant federal laws, including NEPA, the Archaeological Resources Protection Act of 1974 (16 United States Code [U.S.C.] § 469), the American Indian Religious Freedom Act of 1978 (42 U.S.C. § 1996 and 1996a), the Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. § 3001), Executive Order 11593 (Protection and Enhancement of the Cultural Environment) of 1971 (16 U.S.C. § 470), the American Antiquities Act of 1906, and Executive Order 13007 (Indian Sacred Sites) of 1996 (73 Federal Register 65, pp. 18293-24).

ASSOCIATION WITH OTHER STUDIES

For all three projects, the assessment of effects of project operations on historic properties will be informed by the results of hydraulic modeling and operations modeling studies (Study 4 and 5), and the three erosion studies (Study, 1, 2, and 3). These studies will help to understand the spatial extent of project effects on riparian resources including historic resources typically associated with active erosion within the APE.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Existing Information

Archaeological Phase 1A Studies

Phase IA archaeological reconnaissance surveys have been conducted within the recommended APEs (see “Study Area and Study Sites” below) for the Wilder, Bellows Falls, and Vernon Projects to identify known archaeological sites and additional areas of archaeological sensitivity where documented and previously unrecorded sites are likely to exist. The methodology used to conduct those investigations is included in Attachment 33-A.

The Phase IA survey for the Wilder Project identified a total of 48 archaeological sites within the project boundary: 28 sites on flowage lands including river shoreline and 3 sites within fee-owned lands in Vermont; and 16 sites on flowage lands including river shoreline and 1 site within fee-owned lands in New Hampshire. These sites are summarized in Table 3.12-1 in the Wilder PAD (pages 3-146 through 3-153). The Phase IA survey also documented 56 locations that could contain additional archaeological sites (27 in Vermont, 29 in New Hampshire) based on archival research (i.e., historical maps), five of which were identified during the Phase IA survey and assigned archaeological site numbers. The other 51 documented sites were not field-verified during the Phase IA survey. The documented sites are summarized in Table 3.12-2 (Vermont) and Table 3.12-3

(New Hampshire) in the Wilder PAD (pages 3-154 through 3-161). Of the 48 sites identified in the project APE, two are potentially eligible for listing in the National Register, and one is ineligible. The National Register eligibility of the other 45 identified sites within the APE has not been determined.

The Phase IA survey for the Bellows Falls Project identified a total of 43 archaeological sites within the project boundary: 16 sites on private flowage lands, 8 sites on fee-owned lands and adjacent private flowage, and 2 sites on fee-owned lands in Vermont; and 6 sites on private flowage lands, 5 sites on fee-owned lands and adjacent private flowage, and 6 sites on fee-owned lands in New Hampshire. These sites are summarized in Table 3.12-1 in the Bellows Falls PAD (pages 3-157 through 3-165). The Phase IA survey also documented 26 locations that could contain additional archaeological sites (12 in Vermont, 14 in New Hampshire) based on archival research (i.e., historical maps), three of which were identified during the Phase IA survey as corresponding to previously recorded archaeological sites. The other 23 documented sites were not field-verified during the Phase IA survey. The documented sites are summarized in Table 3.12-2 (Vermont) and Table 3.12-3 (New Hampshire) in the Bellows Falls PAD (pages 3-166 through 3-169). Of the 43 sites identified in the project APE, three are currently listed on the National Register, and three are eligible for listing on the National Register. The National Register eligibility of the other 36 identified sites within the APE has not been determined.

The Phase IA survey for the Vernon Project (Cherau and O'Donnchadha, 2008) identified a total of 37 archaeological sites within the project boundary: 28 on fee-owned and private flowage lands in Vermont; and 9 on fee-owned and private flowage lands in New Hampshire. These sites are summarized in Table 3.12-1 in the Vernon PAD (pages 3-182 through 3-188), and include potential site locations documented through archival research (i.e., historical maps). Of the 37 sites identified in the project APE, two are eligible for listing in the National Register, and one of these may also be an unlisted National Historic Landmark. One site is potentially eligible for listing in the National Register. The National Register eligibility of the other 34 identified sites within the APE has not been determined.

The Phase IA archaeological field investigations at the Wilder and Bellows Falls Projects documented erosion along the impoundment shorelines, upstream of Bellows Falls dam and immediately below Wilder dam. The Phase IA surveys were conducted in the months immediately following Tropical Storm Irene (August 2011), and the high flow-related erosion may have been a result of flooding associated with the storm. No high flow-related erosion was observed in the Vernon Project during the Phase IA survey, which was conducted 4 years earlier (August 2007). The archaeological investigations were not designed to ascertain the causation, extent, and mechanics of the observed erosion at the Wilder or Bellows Falls Projects.

Historic Architectural Property Identification and Evaluation

The Vernon, Bellows Falls, and Wilder Projects have previously been determined or evaluated for listing in the National Register as historic districts through a variety of surveys and other types of investigations that have been conducted over time. The following describes the primary efforts that have resulted in the identification and evaluation of those resources.

Hydroelectric Generating Facilities in Vermont Multiple Property Submission

The Vernon and Bellows Falls Projects are identified as being eligible for listing under the Hydroelectric Generating Facilities in Vermont Multiple Property Submission (MPS) (Berger, 1992). The MPS documentation was prepared by Louis Berger & Associates, Inc. in 1992 and was signed by the Keeper of the National Register and entered in the National Register in 2004. It provides the overall context and registration requirements for listing individual hydroelectric power facilities in Vermont that were constructed between 1882 and 1941. The Vernon and Bellows Falls Projects, which were developed in 1909 and 1928, respectively, are identified in the documentation as historic districts that are eligible for listing under the MPS, but neither has ever been formally nominated to the National Register.

Deerfield and Connecticut River Hydroelectric Projects System-wide Historical and Photographic Documentation

A full inventory of historic aboveground properties within the FERC boundaries of the Vernon, Bellows Falls, and Wilder Projects was compiled during a survey conducted by Public Archaeology Laboratory (PAL) in 1999 (Doherty and Kierstead, 1999). The purpose of the survey was to identify and evaluate historic architectural properties within the boundaries of all the hydroelectric developments that are currently owned by TransCanada on the Deerfield and Connecticut Rivers. Survey information was used to evaluate the significance of the resources and prepare state-level written and photographic documentation that meets the standards of the Historic American Engineering Record. The documentation was intended to provide a permanent record of the historic developments and serve as a baseline for assessing the impacts of subsequent project-related undertakings that had the potential to impact their qualities of significance. It included the development of historic context statement for the development of hydroelectric power facilities on the two rivers and the recordation of each of the hydroelectric developments, including information about all individual aboveground resources within the project boundaries that contribute to their historical significance. Copies of the documentation for the Connecticut River Projects were submitted to the VTSHPO and NHSHPO for transmittal to the state archives in those states and local archival repositories in the vicinity of the projects.

Vernon Project

In 2006 TransCanada conducted a project to upgrade the generating capacity at the Vernon Project that required an amendment to the project license. In accordance with Section 106 of the NHPA, FERC and TransCanada consulted with the VTSHPO and NHSHPO and other parties regarding the project's effects on historic properties. The consultation resulted in a determination that the historic architectural resources within the Vernon Project are eligible for listing in the National Register as a historic district under National Register criteria A and C at the state level in the areas of

Industry, Engineering, and Architecture (Table 33-1). It derives its primary historical significance from being the first large capacity electrical generation facility in New England designed to deliver electricity via a long-distance transmission network. The effects of the proposed upgrade project on the historic powerhouse were resolved through the execution of a Memorandum of Agreement that specified a variety of mitigation activities, including the preparation of a Historic Properties Management Plan (HPMP). The HPMP, which was completed and approved in 2008, specifies the treatment and management of historic properties within the Vernon Project boundaries (Olausen and Cherau, 2008).

Table 33-1. List of contributing resources within the Vernon Hydroelectric Project historic district.

Resource Name	Location	Date	Description
Dam	Connecticut River between Vernon, VT and Hinsdale, NH.	1907-1909	956-foot-long, 58-foot-high concrete gravity dam, with a spillway section that includes trash sluice gates, flood gates, tainter gates, and hydraulic flashboards.
Powerhouse	West end of Dam, Vernon, VT and Hinsdale, NH	1907-1909	Rectangular, 328 feet long by 55 feet wide, Renaissance Revival-style building with a steel-frame structural system and brick exterior walls.
Superintendent's House	Governor Hunt Road, Vernon, VT	1907	2½-story, wood-frame, clapboard-sided, Colonial Revival-style house with an asphalt-shingled gable roof. It was built about 1907 to house the Vernon Station's superintendent and his family.
Superintendent's Garage	Governor Hunt Road, Vernon, VT	ca. 1907	One-story, wood-framed, clapboard-sided, gable-roofed garage.
Hoister House	Governor Hunt Road, Vernon, VT	ca. 1907	One-story, clapboard sided, gable-roofed, wood-frame shed. Originally house a compressed air-powered hoist used to haul railroad cars during construction of the project. Currently used for equipment storage.
Pump House	Governor Hunt Road, Vernon, VT	ca. 1909	Brick-walled, one-story shed with a slate-sheathed gable roof. Built to pump potable water to the Powerhouse and the company-built employee dwellings.

Resource Name	Location	Date	Description
Crew Shack	East end of Dam, Hinsdale, NH	ca. 1909	One-story, clapboard-sided, rectangular, building with an asphalt shingle roof. Provided shelter for power company personnel, particularly those working on the dam in bad weather.

Bellows Falls Project

The Bellows Falls Island Multiple Resource Area was listed in the National Register in 1990 (Mulholland et al., 1988). The documentation covered a number of historic resources located on Bellows Falls Island that were associated with the industrial development of the area during the nineteenth and early twentieth century. The Bellows Falls Hydroelectric Powerhouse was named in the documentation as a contributing resource, but the New England Power Company, the owner of the project at that time, objected to its listing in the National Register. In accordance with the Section 101(a)(6) of the National Historic Preservation Act, the Keeper determined the property eligible for listing and provided the appropriate notifications to that effect.

A portion of the canal that provides water to the Bellows Falls powerhouse is a contributing resource within the Bellows Falls Downtown Historic District, which was listed in the National Register in 1982 (Henry, 1981). The boundaries of the district were drawn to exclude the Bellows Falls Hydroelectric Development powerhouse, but a portion of the Canal between Bridge Street on the south and the Green Mountain Railroad Bridge on the north is included in the district.

Other resources, including the dam and several ancillary buildings that may contribute to a potential Bellows Falls Hydroelectric Project Historic District, were identified during the survey that PAL conducted in 1999. Table 33-2 provides a list of the resources that were evaluated as eligible for inclusion in the potential district.

Table 33-2. List of contributing resources within the potential Bellows Falls Hydroelectric Project historic district.

Resource Name	Location	Date	Description
Dam	North Walpole, NH and Bellows Falls, VT	1927	643–foot-long, 30–foot-high, linear, poured concrete, gravity-type structure divided into five ogee-profile spillway sections separated by massive concrete pylons.
Canal	East of Canal Street, Bellows Falls, VT	1802/1927	540 feet long and 100 feet wide, except where it widens slightly to form a forebay immediately above the powerhouse. The walls and floor of the canal are lined with cut granite blocks.
Power House	12 Mill Street, Bellows Falls	1927	Renaissance Revival-style, two-story, cruciform-plan, brick-walled, steel-framed building with a concrete foundation and flat, reinforced concrete slab roofs with raised parapets.
Gauge House	Intersection of Church and River Sts, North Walpole, NH	ca. 1927	Rectangular, one-story, brick-walled building with an asphalt-shingled ridge-hip roof.
Crew Shack	Intersection of Church and River Sts, North Walpole, NH	ca. 1930s	One-story, three bay by two bay, wood-frame building with a concrete slab foundation, clapboard siding, and an asphalt-shingle gable roof.
Six-man Garage	South of Bridge Street, Bellows Falls, VT	ca. 1875	long, narrow, one-story, rectangular brick building built on fieldstone and concrete foundations, attached to east wall of the canal.
Line Shed	Mill Street, Bellows Falls, VT	ca. 1940	One-story, square-plan, wood-frame building with a concrete slab foundation, corrugated metal walls, and a shallow-pitch, corrugated metal gable roof.
Red Barn	West end of Pine Street at Connecticut River, North Walpole, NH	ca. 1870	Greek Revival-style, rectangular, two-story, brick-walled, building with a fieldstone and concrete foundation and a slate-sheathed gable roof with corbeled brick cornices and returns.

Wilder Project

The Wilder Project has never been formally determined eligible for listing in the National Register. The project was included in PAL's 1999 survey and was evaluated at that time as potentially eligible for listing. The contributing resources of the potential district are identified in Table 33-3.

Table 33-3. List of contributing resources within the potential Wilder Hydroelectric Project historic district.

Resource Name	Location	Date	Description
Powerhouse	351 Wilder Dam Road, Hartford, VT	1950	Colonial Revival-style, rectangular, 183-foot-long, 46-foot-wide, 60-foot-high, six-by-one-bay, two-story building with a high concrete foundation, brick-clad, steel-frame walls, and a slate-sheathed gable roof.
Dam	Wilder Dam Road, Hartford, VT; Rte 10, Lebanon, NH	1950	2,900-foot-long earth and concrete dam, consisting of a 2,100-foot-long earthfill structure and a 680-foot-long, 59-foot-high, linear, poured concrete gravity-type structure with an ogee-profile spillway.
Old Visitor's Center	Rte 10, Lebanon, NH, south end of Wilder Dam	ca. 1950	Rustic-style, one-story, cruciform-plan building with a concrete foundation and an asphalt-shingled gable roof.
Garage	Wilder Dam Road, Hartford, VT	ca. 1950	40-foot by 120-foot, wood-framed, one-story building with a concrete slab foundation, and corrugated metal gable roof and siding
Oil Storage Shed	Wilder Dam Road, Hartford, VT	ca. 1950	One-story, rectangular, two-by-one-bay, steel frame building with a concrete slab foundation, pressed metal clapboard siding, and a corrugated metal gable roof.

Need for Additional Information

FERC has requested a complete inventory of historic properties within the Wilder, Bellows Falls, and Vernon Projects through Phase IB identification surveys and National Register evaluations during first and second season field investigations. The VTSHPO specifically requested that the project APE for Wilder, Bellows Falls, and Vernon be enlarged to include all terrace margins and adjacent areas where active erosion is destabilizing the riverbanks within the project corridors. Pending the definition of the project APEs by FERC in consultation with the SHPOs and Native American tribes, particularly in relation to project operations and erosion, Phase IB archaeological surveys and Phase II evaluation studies through second season field investigations, if necessary, will be conducted. The need for Phase IB survey for the Vernon Project will be determined following the scheduled 2013 Archaeological Monitoring Program as described in the 2008 Vernon HPMP. Identification of TCPs will be conducted by a qualified ethnographer[7] who will consult with Native American tribes who have identified themselves as having a traditional connection to the project corridors.

PROJECT NEXUS

Activities related to the operation and maintenance of the Wilder, Bellows Falls, and Vernon Projects over the license term have the potential to affect cultural resources that are eligible for listing in the National Register. Phase IB archaeological site identification and Phase II archaeological site evaluation studies will identify National Register-eligible archaeological sites that may be directly or indirectly affected by project operations and maintenance activities. Similarly, a National Register evaluation of the historic hydroelectric components of the Wilder Project will complete the identification of historic aboveground properties. Inventory of TCPs, including sacred landscapes, will be conducted by a qualified ethnographer in coordination with Native American tribes, specifically the Narragansett Indian Tribe and the Nolumbeka Project. The information obtained from these identification and evaluation efforts will be used to assess the potential effects of the relicensing of the three projects on cultural resources.

In the event that FERC, in consultation with the VTSHPO and NHSHPO and Native American tribes, determines that project relicensing has the potential to cause adverse effects on historic properties, the information will form the basis of continued consultation to resolve the effects. The product of that consultation will likely be a PA developed for each of the projects that stipulates actions that will be taken to avoid, minimize, or mitigate the adverse effects. One of the key provisions of the PAs will be the development of new HPMPs for the Wilder and Bellows Falls Projects and the revision of the existing Vernon HPMP.

STUDY AREA

The study area for cultural resources corresponds to the APEs established pursuant to 36 C.F.R. § 800.4(a)(1). The APE is defined as the geographic area or areas

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[7] "Qualified ethnographers" shall meet the professional qualifications for ethnography requirements identified in Appendix II of National Register Bulletin 38, *Guidelines for Identifying and Evaluating Traditional Cultural Properties* (National Park Service, 1998). http://www.nps.gov/nr/publications/bulletins/nrb38/nrb38%20apendix%202.htm

within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The APE is influenced by the scale and nature of an undertaking and may consist of multiple areas to address different kinds of effects caused by the undertaking (36 C.F.R. § 800.16(d)).

The recommended APE for all three projects is defined as all land within the FERC project boundaries owned in fee simple by TransCanada and 10 meters (33 feet) of land inland from the top of bank in areas along the Connecticut River and affected portions of tributaries where TransCanada holds flowage rights. The recommended project APE map sheets (USGS 7.5-minute topographic quadrangles) for the Wilder, Bellows Falls, and Vernon Projects are included as Attachment E to the document "Responses to Commission Staff's Identification of PAD Deficiencies, Requests for Additional Information and Status of Study Reports," which is being filed simultaneously with FERC. Copies of those maps are attached here as Attachment 33-B.

METHODOLOGIES

Review of Bellows Falls and Wilder Project Phase IA Archaeological Reconnaissance Survey Reports

Phase 1A reports for the Wilder Project and Bellows Falls Project were submitted to the VTSHPO and NHSHPO and NITHPO on May 29, 2013. Phase 1A reports for these projects together with the 2008 Phase 1A report for the Vernon Project were also submitted to FERC on July 1, 2013. The Phase IA report for the Vernon Project was provided to the NITHPO on June 19, 2013. The draft reports include copies of all SHPO consultation to date. The submittal of the final reports will follow the draft review.

Vernon Project 2013 Monitoring Program / Update of Phase 1A Archaeological Reconnaissance Survey Report

The archaeological monitoring program, as described in the Vernon HPMP (Olausen and Cherau, 2008:25-26), will be implemented by qualified archaeologist(s) assisted as needed by a geologist, soil scientist, forester, and/or engineer with physical, geotechnical, or hydraulic experience pertinent to riverine hydraulics, reservoir operation and erosion, depending on the condition of the sites and locales to be visited. The monitoring program will include a physical inspection of previously identified archaeologically sensitive shoreline areas and sites with the goal of updating the initial Phase IA archaeological survey report prepared by PAL in 2008 (Cherau and O'Donnchadha, 2008). Native American Tribal representatives will accompany the archaeologists during this field work, if so desired, to collect existing conditions data on TCPs, including sacred landscapes, during the visual inspections.

Should erosion or other threats to sensitive areas and/or sites be identified during the monitoring, a Phase IB identification survey of the affected areas will be conducted (see "Methodology" described below). For the known National Register-eligible sites or other sites subsequently identified as eligible for listing in the

National Register, any identified threats will be addressed through controls or other measures designed to preserve their integrity. Threats that cannot be checked or otherwise resolved may require mitigation through the implementation of a Phase III archaeological data recovery program. The findings of the monitoring effort will be presented in a stand-alone report that will be submitted to FERC, VTSHPO, NHSHPO, and Native American tribes.

Phase 1B and Phase II Archaeological Investigations

As determined in consultation with FERC, the SHPOs, and Native American tribes, Phase IB surveys will be conducted in the Wilder, Bellows Falls, and Vernon APEs to locate and identify known and undocumented archaeological resources in areas of active erosion or other identified project-related impacts. Phase II field evaluations will be conducted, as needed, to determine the National Register eligibility of identified archaeological sites. Phase IB survey will be completed during the 2014 field season. Phase II site evaluations, if necessary, will also be conducted in the 2014 field season. Phase IB survey and Phase II methodologies will be reviewed and approved by the VTSHPO and NHSHPO prior to the start of field work. The survey methodologies will be designed and implemented in accordance with the standards and guidelines set forth by the Secretary of the Interior's *Standards and Guidelines for Archaeology and Historic Preservation* and Section 106 of the National Historic Preservation Act of 1966, as amended, and related regulations (36 C.F.R. § 800); the VDHP/SHPO's *Guidelines for Conducting Archeology in Vermont* (final adoption June 2007); and the NHDHR/SHPO's Archaeological Standards and Guidelines.

Native American Tribal representatives will be notified of the Phase IB and II schedules and will, if so desired, accompany the archaeologists during the field work in order to collect data on identified Native American sites and TCPs including sacred landscapes.

Phase IB Identification Surveys

Phase IB identification surveys will be conducted in archaeologically sensitive areas where active erosion was identified during the Phase IA surveys including the 2013 monitoring program for Vernon. These archaeologically sensitive areas will include the borders of active shoreline erosion up to 10 meters (33 feet) back from the top of the embankments. Bordering areas on private property that were not included in the Phase IA surveys will initially be subjected to a complete walkover with close ground surface inspection to assess existing conditions and the presence of visible cultural materials. The results of the walkover survey will inform the locations of Phase IB subsurface testing designed to locate and identify archaeological deposits including small sites that may be present. The Phase IB identification surveys including additional walkover and subsurface testing will be conducted in consultation with the VTSHPO and/or NHSHPO. For this proposal, Phase IB survey will be conducted in archaeological site and sensitive areas where direct project impacts are occurring, and as identified during the Phase IA surveys and depicted on the Appendix B maps included in the Phase IA survey reports.

If access to private property is needed for the additional walkovers and subsurface testing, landowner permissions will be obtained by TransCanada prior to the start of field work. No field work will be conducted on private lands where landowner permission has not been obtained by TransCanada. The correspondence relating to landowner permissions will be included in the project survey files.

In areas where landowner permission is obtained, Phase IB subsurface testing will initially be conducted in the form of shovel test pits placed at 10-meter intervals along linear transects within 10 m of the river bank. The hand testing will be designed to investigate sensitive soil strata to depths up to 100 cm below ground surface (3 feet). Based on the Phase IA survey, cultural deposits and sensitive soil strata are present at these shallow depths where hand testing is the preferred method of excavation. Approximately 2,000 test pits will be excavated in the archaeologically sensitive areas and potential site locations within the APE based upon linear estimates of active bank erosion in Wilder, Bellows Falls, and Vernon Projects.

All Phase IB survey test pits will measure 50-x-50- cm in size and will be placed at 10- m intervals along transects, and at 2.5- and 5-meter intervals in test pit arrays where potentially significant cultural materials are identified during the initial testing. All test pits will be excavated by shovel in arbitrary 10-cm levels to at least 100 cm below the ground surface and/or sterile glacial subsoils. All excavated soil will be screened through 0.25-inch hardware cloth, and remaining cultural material will be collected. Soil horizons/profiles will be recorded using Munsell soil descriptions for each unit. Cultural material and samples will be bagged and labeled with provenience information. Digital photographs will be taken of the project APE areas subjected to subsurface testing. Test pit soil profiles will be photographed if they contain potentially significant cultural features, soil anomalies, and/or structural remains. All test units and cultural deposits will be located using GPS technology and plotted on USGS 7.5 minute topographic maps and project plans.

All cultural materials, including those that may be identified by Native American tribal representatives, collected during the Phase IB surveys will be returned to the PAL facility in Pawtucket, Rhode Island, for laboratory processing and analyses. These activities will include: cleaning, identification, and cataloging of any recovered cultural materials; analysis of spatial distributions of cultural materials; and map and graphics production.

Results of the hand testing, along with an analysis of geotechnical data generated through previous and ongoing geofluvial studies of the river shorelines will be used to inform on the potential presence of deeply buried cultural deposits in identified site and sensitive areas. If deep sensitive strata are identified, further Phase IB subsurface investigations will be conducted to investigate the presence of cultural deposits. These investigations may be in the form of geoarchaeological coring and/or larger hand or machine-assisted excavations within 10-meter of the top of the riverbank or into the riverbank escarpments where safety measures meeting the Occupational Safety and Health Administration's regulations can be effectively implemented.

Detailed scope of work/methodologies for all Phase IB investigations will be developed and submitted for review to the FERC, VTSHPO, NHSHPO, and Native American tribes prior to the initiation of field work.

Phase II Site Evaluations

If potentially significant archaeological deposits be identified during the Phase IB investigations in areas of active erosion or other project impacts, then additional testing in the form of Phase II evaluations will be conducted during the 2014 field season. Archaeological sites identified during the Phase IA surveys in other portions of the APE not subjected to Phase IB survey will be treated as significant resources for the purposes of Section 106 until additional archaeological investigations to determine their boundaries and NR eligibility are conducted. The treatment and protection of these sites along with a phased plan to complete Phase II site evaluations will be addressed in each project's HPMP.

Phase II evaluations will consist of the excavation of shovel test pits (50-x-50-cm) and larger units (combinations of 1-x-1 meter squares) for shallow (up to 100 cm below the ground surface) cultural deposits in each identified site area. Note: if deeper cultural deposits are present, the site-specific testing methodologies to investigate these deep resources will be developed in accordance with the information obtained during the Phase IB surveys. The shovel test pits will be used to determine the archaeological site boundaries along with natural landforms, historic and/or modern structures/features, and artificial (disturbed) elements. The larger units will be hand excavated to examine cultural material concentrations and/or features (e.g., fire pits, hearths, privies) and inform on the age and internal configuration/complexity of the site. This information will be used to assist in a determination of the site(s)' significance and their eligibility to meet the criteria for listing in the National Register.

The exact placement and amount of Phase II testing at each identified site area will be based on the results of the Phase IB surveys. The Phase II excavation and recordation procedures will follow those established above for the Phase IB survey subsurface testing. Detailed scope of work/methodologies for all Phase II site evaluations will be developed and submitted for review to the FERC, VTSHPO, NHSHPO, and Native American tribes prior to the initiation of field work.

Archival research including land evidence records and local town histories will be conducted as needed for any potentially significant post-contact period sites. The research will be used to refine archaeological site boundaries in relation to historic property divisions and assist in applying the National Register criteria of eligibility to these resource types.

If National Register eligibility determinations for identified archaeological sites cannot be made during the first and second field seasons, the need for follow-up site evaluations to determine National Register eligibility will be included in each project's HPMP.

TCP Identification Survey

The effort to identify and evaluate TCPs within the Wilder, Bellows Falls, and Vernon Projects will be led by an ethnographer who meets the qualifications defined by the NPS in its Guidelines for Evaluating and Documenting Traditional Cultural Properties, Appendix II (Parker and King, 1998:27). The ethnographer will be selected in consultation with Native American tribal representatives, including the NITHPO and Nolumbeka Project, who have identified themselves as having a traditional connection to the project corridors. The study area for the TCP survey will conform to the recommended APEs established for the Wilder, Bellows Falls, and Vernon Projects, which have been established through consultation with the VTSHPO, NHSHPO, NITHPO, and Nolumbeka Project.

The ethnographer will carry out research in tribal archives and local and state repositories to gather available archival information about the occupation and traditional use of land and resources within the study area by Native Americans. The research will include a review of cultural resource management reports that have been completed for the study area, including the Phase IA archaeological survey reports that have been completed for the Wilder, Bellows Falls, and Vernon Projects. The ethnographer will also conduct interviews with knowledgeable Native American informants. The scope of the interviews will be determined in consultation with tribal representatives, including the NITHPO and other tribes and stakeholders. The ethnographer will coordinate with tribal interviewees to obtain Traditional Ecological Knowledge, if applicable.

Upon completion of the research and interviews, the ethnographer, tribal representatives, and potentially the interviewees, may determine it necessary to visit areas within the APEs. The purpose of the visits would be to 1) allow tribal representatives to show locations identified during the interviews, 2) document and map locations, 3) verify potential correlations with known archaeological resources, 4) identify any potential project-related effects, (5) determine potential correlations with known archaeological resources, and 6) enable the ethnographer to obtain any additional information on the potential TCPs.

Following the site visit, the ethnographer, in consultation with participating tribes, will evaluate the eligibility of identified TCPs for listing in the National Register. The evaluation will employ the National Register criteria and guidance for evaluating and assessing the integrity of TCPs contained in the *Guidelines for Evaluating and Documenting Traditional Cultural Properties* (NPS, 1998).

If participating tribes or individuals do not wish to disclose the locations of any potential TCPs due to religious or confidentiality reasons, the ethnographer shall instead work with the Tribes and individuals to identify the general issues and concerns that they may have regarding potential impacts of the project upon known resources. Agreeable measures to alleviate these concerns will be addressed in the project HPMP.

The results of the TCP study will be presented in a report prepared by the ethnographer. The report will include sections that detail the study goals and objectives, methodology employed, historical context statement, results of the TCP identification effort, recommendations regarding the eligibility of identified TCPs for listing in the National Register, and an appendix of TCP records. The report will be provided to the Narragansett NITHPO and Nolumbeka Project research staff, and other interested tribal representatives as appropriate for review of its findings. After receipt of comments, the report will be revised to address those comments and forwarded to the FERC and SHPOs for review and concurrence.

Survey and Evaluation of Historic Architectural Resources

The survey of historic architectural resources will assess existing condition of all resources that were previously identified in the 1999 survey conducted by PAL, identify any other potentially significant resources within the APEs, and evaluate the significance of resources that have not yet been formally determined eligible for listing in the National Register. The work will be conducted in the following manner.

The historic architectural survey and evaluation will be carried out by a team consisting of an architectural historian and industrial historian who meet the Secretary of the Interior's Professional Qualification Standards (36 C.F.R. § 61, Appendix A). The initial phase of the survey will consist of a review of available sources and documentation regarding the history of the hydroelectric projects. The review will include visits to the VDHP and NHDHR offices (the SHPOs) to review inventory records and other relevant files they may contain.

The field survey will consist of walkover of the lands within the project APEs. The team will visit each of the previously identified resources and document any other resource that appears to be 50 years of age or older. Information about the current appearance, including the setting, physical condition, and character-defining architectural features of the resources, will be recorded. High-resolution digital photographs will be taken of each resource. Additional photography will include general context views that show the resources in relation to one another and their surroundings. A photo log will be kept, and the locations of the views will be recorded on a base map.

Upon the completion of the field investigations, PAL will analyze all collected data and prepare historical contexts that identify the significant themes, events, and/or people that had an impact on the historical development of the potential districts. The historic contexts and field notes regarding integrity will serve as the basis for the National Register evaluation of the district and individual resources that contribute or do not contribute to its significance. PAL will determine the areas, period(s), and level(s) of significance for the district and apply the National Register criteria for evaluation. The integrity of the resources will be evaluated to determine if the properties retain a sufficient amount of their historic appearance to be considered for listing in the National Register.

The product of the survey will be a report that provides information about previous National Register evaluations and recommendations regarding the potential National Register eligibility of resources that have not been formally evaluated. The reports will contain a narrative description of the resources identified during the survey, including information about the general setting and current physical condition. The narrative will provide a statement of integrity that addresses changes that have occurred over time.

The description will be followed by historic context statement that will provide information about the general historical development of hydroelectric facilities on the Connecticut River during the early twentieth century and other themes, if any, that may apply to resources identified in the field.

The recommendations section of the report will include the results of the National Register evaluation for the potential Wilder and Bellows Falls Hydroelectric Project Historic Districts and any updates of the Vernon Hydroelectric Project Historic District, which has previously been determined eligible for listing in the National Register. Recommendations will include a narrative statement of significance that will define the applicable National Register criteria, criteria considerations (if any apply), areas of significance, and periods of significance for the districts. The narrative will include a summary statement of significance that will establish the level(s), period(s), and areas of significance. Each area of significance will be supported by a statement that identifies the historical development of the district and defines the themes, trends, events, and people that are important in American history and lend the district its significance.

Other components of the report will consist of a bibliography of sources consulted and graphical information, including a map of the district and photographs of the contributing and non-contributing resources. The map will be prepared in ArcGIS format and will include the scale, north arrow, and legend. All contributing and non-contributing resources and prominent landscape features will be clearly labeled to correspond with information provided in the district data sheet. The map will also show the district boundaries and location of views corresponding to the photographs included with the documentation.

Development of Historic Property Management Plans

HPMPs will be developed for the Bellows Falls and Wilder Projects, and the existing HPMP for the Vernon Project will be updated prior to the issuance of a new FERC license. The HPMPs will govern future actions as they relate to historic properties, including standing structures and archaeological sites, within the project boundaries. The HPMPs will identify the nature and significance of historic properties within the project boundaries that may be affected by project-related maintenance and operation, proposed improvements to project facilities, and public access. The HPMPs will identify goals for the preservation of historic properties; establish guidelines for routine maintenance and operation; and establish consultation procedures. They will identify the responsible TransCanada officer in charge of executing the plan and establishing procedures for training plant operators, maintenance staff, and other employees in its implementation. The HPMPs will be integrated with existing management plans, as appropriate.

The HPMP for each project will be developed according to the following principles and procedures:

- **Consultation.** The HPMPs will be prepared through a process that will involve consultation with, and input from FERC, VTSHPO, NHSHPO, Native American tribes, historic preservation experts, and other interested parties that may be identified.

- **Identification and Evaluation of Historic Properties.** The HPMPs will identify known historic properties within the projects and specify future phased efforts that will be carried out to determine the significance of any identified, but unevaluated resources within the project APEs.

- **Routine Project Operations.** The HPMPs will include a description of how historic properties, including known and predicted archaeological resources, are or could be affected by routine project operations. This discussion will include the suspected or known cause of an effect on each site or feature. The HPMPs will identify and prioritize preservation issues associated with routine project operations.

- **Protection of Historic Properties.** The HPMPs will address the continuation of routine project operations in relation to the protection of the integrity of historic properties. These operations include, but are not limited to: continued use and maintenance that affects historic properties, shoreline erosion caused by routine operations, recreational developments, other project-related ground-disturbing activities, and vandalism.

- **Mitigation of Adverse Effects.** The HPMPs will include a process for determining and mitigating unavoidable adverse effects on historic properties.

- **Discovery of Human Remains.** The HPMPs will include mechanisms for the treatment and disposition of any human remains that may be discovered, taking into account applicable Vermont and New Hampshire state laws and the Advisory Council on Historic Preservation's *Policy Statement Regarding Treatment of Human Remains and Grave Goods*.

- **Discovery of Previously Unidentified Properties During Project Operations.** The HPMPs will include a plan to evaluate previously unidentified resources that may be discovered in the future during project operations.

  Public Interpretation. The HPMPs will specify the implementation of a program to provide interpretation of the historic and archaeological values of the projects to the general public.

ANALYSIS

The results of proposed Phase IB and Phase II archaeological surveys, TCP identification survey, and National Register evaluation report for historic architectural resources will be used to determine the potential for adverse effects to historic properties created by the continued operation of the Wilder, Bellows Falls, and Vernon Projects. The information on potential effects will be used as the basis for preparing the HPMPs for each of the projects, which will guide TransCanada's actions relating to Section 106 during the term of the new licenses.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The archaeological monitoring/Phase 1A survey update at Vernon as well as any subsequent Phase IB survey and Phase II investigations that may be necessary will be conducted according to the applicable federal and state regulations and guidelines. The archaeological surveys in Vermont will be conducted in accordance with VDHP/SHPO *Guidelines for Conducting Archeology in Vermont*, dated June 2007 (final adoption). In New Hampshire, the archaeological surveys will be conducted in accordance with the NHDHR *Archaeological Standards and Guidelines*. In addition, all surveys will meet the standards and guidelines set forth by the Secretary of the Interior's *Standards and Guidelines for Archaeology and Historic Preservation* and Section 106 of the NHPA.

DELIVERABLES

The 2013 cultural resource reporting deliverables for the Wilder, Bellows Falls, and Vernon Projects are as follows:

- final Phase IA archaeological reconnaissance survey reports for the Wilder and Bellows Falls Projects;
- draft and final Vernon 2013 archaeological monitoring program/Phase 1A survey update report;
- TCP identification survey, progress report for the Wilder and Bellows Falls Projects, based on preliminary research and visual inspections; and
- historic architectural resources National Register evaluation report.

The 2014 cultural resource reporting deliverables for the Wilder, Bellows Falls, and Vernon Projects will follow the completion of first and second season Phase IB survey and Phase II evaluation field work, research, and laboratory analyses.

- Phase IB Archaeological Identification Survey and Phase II Evaluation reports for the Wilder, Bellows Falls, and Vernon Projects. Draft report(s) will be prepared for comment by the SHPOs and Native American tribes. Each technical report will contain a description of the project APE, cultural contexts, results of the field work, and conclusions and recommendations for the treatment of identified National Register-eligible sites. The reports will each contain maps showing the project APE, testing locations, and all identified archaeological sites. The final reports will follow the draft review.

- TCP identification survey, final reports for the Wilder, Bellows Falls, and Vernon Projects, based on the results of research and field work.

SCHEDULE

The final Phase IA archaeological reconnaissance reports for Wilder and Bellows Falls will be submitted following the draft review by FERC, VTSHPO, NHSHPO, and the Narragansett Indian Tribe.

The Vernon archaeological monitoring program is scheduled to be conducted in the summer of 2013. A draft report of the 2013 monitoring program findings will be prepared and filed with FERC, ,VTSHPO, ,NHSHPO, and Narragansett Indian Tribe within 30 days following the field work, anticipated to be no later than September 30, 2013. The final report will follow the draft review and be submitted by December 31, 2013.

The Historic Architectural Resources National Register Evaluation Report will be prepared and filed with FERC, , VTSHPO, and NHSHPO by September 30, 2014.

Phase IB survey field work will begin during the 2014 field season. The Phase II site evaluation field work will begin continues and/or be completed in the 2014 field season. The draft reports for the first and second field season investigations will follow the completion of field work and laboratory analysis, with an anticipated submittal date of August 2014. Due to the sensitive nature of the information that will be provided in the archaeological reports, they will be issued as stand-alone documents and will only be distributed to the SHPOs, involved tribes, and FERC.

The schedule for the completion of the TCP inventory and reporting will follow the schedule established above for the archaeological survey and reports. The information on TCPs generated by the Native American tribes may be incorporated into the archaeological report narratives for both the 2013 and 2014 field season deliverables.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for the study broken down by major tasks is as follows:

- submittal of Final Wilder and Bellows Falls Phase 1A reports and SHPO and stakeholder consultation: $1,500;

- Vernon 2013 Monitoring/Phase 1A Survey Update: $30,000;

- TCP Identification Survey Reports for Wilder, Bellows Falls, and Vernon Projects: $75,000;

- Historic Architectural Resources National Register Evaluation Report: $15,000;
- Phase 1B Archaeological Survey: $250,000 to $280,000;
- Phase II Archaeological Survey: unknown pending the results of Phase 1B investigations; and
- development of new HPMPs for Wilder and Bellows Falls and revised HPMP for Vernon: $50,000 to $55,000.

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ATTACHMENT 33-A
Phase IA Archaeological Reconnaissance Surveys

TransCanada has completed Phase IA archaeological reconnaissance surveys of the recommended APEs at the Wilder, Bellows Falls, and Vernon Projects. The Phase IA surveys were undertaken by TransCanada as the first step in the identification and treatment of significant archaeological resources to assist FERC in fulfilling its obligations under Section 106 of the NHPA of 1966 as amended. The Phase IA surveys were completed by professional archaeologists who meet the qualifications set by the National Park Service (36 C.F.R. § 66, Appendix C) and have at least two years of supervisory experience and two years of field experience in New England.

The Phase IA survey of the Vernon Project APE was conducted in the fall of 2007. The survey methodology and results are presented in the technical report titled *Phase IA Archaeological Reconnaissance Survey, Vernon Hydroelectric Project (FERC No. 1904), Windham County, Vermont and Cheshire County, New Hampshire* (PAL report, Cherau and O'Donnchadha, March 2008). The Wilder and Bellows Falls surveys were conducted in the fall of 2011. The survey methodologies and results are presented in the technical reports titled *Phase IA Archaeological Reconnaissance Survey, Wilder Hydroelectric Project (FERC No. 1892), Windsor and Orange Counties, Vermont and Grafton County, New Hampshire* (PAL report, Hubbard et al., May 2013) and *Phase IA Archaeological Reconnaissance Survey, Bellows Falls Hydroelectric Project (FERC No. 1855), Windham and Windsor Counties, Vermont and Cheshire and Sullivan Counties, New Hampshire* (PAL report, Hubbard et al., May 2013).

The technical reports comply with the standards and guidelines set forth by the Secretary of the Interior's *Standards and Guidelines for Archaeology and Historic Preservation* and Section 106 of the National Historic Preservation Act of 1966, as amended, and related regulations (36 C.F.R. § 800); the VDHP/SHPO's *Guidelines for Conducting Archeology in Vermont* (final adoption June 2007); and the NHDHR/SHPO's Archaeological Standards and Guidelines.

Goals and Objectives

The Phase IA archaeological reconnaissance surveys were designed to inventory previously recorded archaeological sites and identify additional areas of archaeological sensitivity where documented and unrecorded sites are likely to exist within the recommended APEs for the Wilder, Bellows Falls, and Vernon Projects. This phase of survey did not include any Phase IB or Phase II subsurface investigations to locate, identify, and evaluate previously documented and undocumented sites for their eligibility for listing in the National Register, or an assessment of existing or future project effects on any such identified historic properties within the project APEs.

Methodology

To accomplish this objective, two research strategies were used: (1) archival research, including a review of literature and maps; and (2) field investigations, consisting of a riverine and shoreline visual survey carried out from a boat, and a terrestrial walkover/surface inspection of upland (shoreline and non-shoreline) fee-owned parcels within the projects. The field survey for private lands where TransCanada only has flowage rights included the impoundment or river channel and adjacent lands affected by the normal operating range of the project's reservoir. The flowage rights areas were examined primarily from the boat. The field crew did not access any privately owned lands during the Phase IA survey field work.

The archival research and field investigations provided the information needed to develop environmental and historic contexts for the project study area and develop a predictive model for archaeological sensitivity. Archaeological sensitivity is defined as the likelihood for belowground cultural resources to be present and is based on various categories of information: locational, functional, and temporal characteristics of previously identified historic properties in the project area or vicinity; and local and regional environmental data reviewed in conjunction with existing project-area conditions documented during the field investigations and archival research about the project's land-use history.

Archival Research

Specific sources reviewed as part of the archival research for the Phase IA reconnaissance survey of the Wilder, Bellows Falls, and Vernon Projects include:

1) State Site Files, Artifact Collection Reports, and Town Reconnaissance Surveys

The state site files at the VDHP and NHDHR were reviewed to locate any known Native American and EuroAmerican sites in or close to the project lands. The VDHP and NHDHR inventories include cultural resources listed or eligible for listing in the National Register of Historic Places. Both sets of files also include an inventory of known archaeological site locations, catalogs of cultural material, and brief site summaries. The VDHP has also assembled a comprehensive survey of Vermont towns and compiled brief outlines of their historical development. Cultural contexts and artifact collection studies were reviewed in the *Journal of the Vermont Archaeological Society* and the *New Hampshire Archeologist* for data relevant to the Connecticut River Valley.

2) Cultural Resource Management Reports

Cultural resource management (CRM) survey reports previously conducted within the general project vicinities were reviewed for relevant information concerning known archaeological sites, sensitivity models and assessments, and environmental and cultural contexts. These reports include studies conducted by PAL and other cultural resource management firms in the Vermont and New Hampshire project towns. The specific cultural resource management reports consulted for each project area are fully described in the corresponding technical Phase IA survey reports.

3) Histories, Maps, and Photographs

Primary and secondary histories and historical maps and atlases of the project towns in the Connecticut River Valley were examined to assess changes in land use, to locate any documented structures, and to trace the development of transportation networks, an important variable in the location of post-contact period archaeological sites. The specific historical town, county, and state maps reviewed for the Vermont and New Hampshire portions of the projects are fully described in the corresponding technical Phase IA survey reports. Historic photographs of project-specific locales including the village of Wilder and the village of Bellows Falls, Vermont including project fee-owned lands and Connecticut River shoreline before, during, and after the construction of the Wilder and Bellows Falls Hydroelectric Development powerhouses and dams were also reviewed as part of the Phase IA survey research. The University of Vermont's Landscape Change Project website, which contains 1000+ digital images of Vermont places. The website includes a quick search function that allows users to key in place names to locate historic images.

4) Environmental Studies

Bedrock and surficial geological studies provide information about the region's physical structure and about geological resources within and near the projects. The United States Department of Agriculture Soil Conservation Service soil surveys of the Vermont and New Hampshire portions of the projects supplied information about soil types and surficial deposits and the general categories of flora and fauna that these soil types support. Information relating to project operations and previous erosion studies and corresponding GIS databases for each project preparation by TransCanada were also reviewed during the Phase IA surveys.

Field Investigations

Following the initial analysis of known sites and sensitivity provided by the archival research, field investigations were conducted to familiarize the archaeologists with the project APE, ground-truth preliminary hypotheses concerning topography and resource potential, and collect information about project effects (including shoreline erosion). The field work for all three projects was conducted in the fall months, and as such was able to focus on the impoundment shorelines as they exist at the normal operating levels upstream of the Wilder, Bellows Falls, and Vernon dams.

The field work was conducted using a combination of boat and pedestrian/vehicle survey. Portions of the project APE away from the shoreline on fee-owned lands where known sites are reported or documented and/or potentially sensitive landforms exist were examined on foot. The field crew also surveyed along a linear transect parallel to the top of the riverbanks. This ensured visual coverage of lands within the operating range for the lands along the impoundment upon which flowage rights are held by TransCanada. Close visual inspection of the shoreline from water's edge to top of the embankments was performed particularly to identify any surface indications of Native American resources such as artifact scatters and exposed hearth/pit features eroding from the banks.

Some confounding environmental factors in the survey of the Wilder and Bellows Falls Project shorelines were the presence of vegetation and a thick layer of gray silt deposited in late August 2011 during flooding from Tropical Storm Irene. The presence of vegetation on the river banks was generally a good indication of river bank stability given the magnitude of the recent flooding events. Siltation and in some case the formation of new sand bars is somewhat more ambiguous. On the one hand it represents a net deposition of sediment in some places, which may actually provide extra protection to archaeological sites. This is especially true where it was deposited by overbank flooding and generally lacked the energy to break up the existing organic root mat. In other cases, where the silt was deposited directly on active erosional surfaces, it hampered the archaeologists' ability to observe cultural materials and features. Other observations concerning the present physical condition of the project shorelines included the presence of artificial disturbances (e.g., recent construction, docks, landings, causeways, and bridge abutments and structures).

All of the Vernon Project shoreline was assessed from the boat. The majority of the Wilder and Bellows Falls Project shorelines were assessed from the boat, but there were instances where closer inspection required debarking. Circumstances that warranted leaving the boat included any place there was a known site or cultural materials/features were observed from the boat using binoculars, areas determined to have a heightened archaeological sensitivity based on established criteria, and areas where significant erosional surfaces could not be adequately observed from the boat. Because most of the shoreline is privately owned, feature recording was limited to light trowel scraping of visible soil anomalies or features needed to verify the presence of cultural materials. This technique served to limit the amount of disturbance that would contribute to the natural erosion of the river bank. Digital photographs and GPS coordinates were taken in lieu of detailed profiles and measurements, and no cultural materials were collected from private property. Digital photographs and GPS points were also taken of existing conditions at all known or newly discovered sites and of all features and artifacts observed in the field.

The reconnaissance survey of visible historic site locations was limited to the same close ground-surface and shoreline inspections. The documented locations of post-contact period sites, particularly those noted on nineteenth-century town maps, were specifically targeted for visual inspection.

All previously recorded and newly identified archaeological site locations within the project shoreline and fee-owned parcels were surveyed with the aid of a Trimble GeoXM submeter model, in combination with VDHP and NHDHR site file information and current study area maps.

Archaeological Sensitivity Assessment

Information collected during the archival research and the riverine and terrestrial field surveys was used to develop a predictive model of potential site types and their cultural and temporal affiliation. The development of predictive models for locating archaeological resources has become an increasingly important aspect of cultural resource management planning.

The predictive model considers various criteria to rank the potential for the project to contain archaeological sites. The criteria are proximity of recorded and documented sites, local land use history, environmental data, and existing conditions. The project shoreline and fee-owned lands were stratified into zones of expected archaeological sensitivity to guide future land management and planning activities. A full discussion of the pre-contact, contact, and post-contact period sensitivity models used in New England is included in the corresponding technical Phase IA survey reports.

The VDHP has formulated an environmental predictive model (VTEPM) for locating pre-contact/contact Native American habitation sites within the state. Based in large part on Thomas's predictive site location model, individual environmental variables are first grouped by class (rivers and streams, wetlands, etc.) and then assigned a positive or negative numerical ranking. Using this score sheet, an area can be sensitized by determining the presence/absence of the specific variables, combining the associated scores, and comparing the total score to a predetermined valuation scale; a score of less than 32 is assessed as archaeologically non-sensitive while a score of greater than 32 is considered archaeologically sensitive. While this method is necessarily broad in scope and must be refined through careful field inspection, it does provide a preliminary indication of the archaeological sensitivity of an area. The full discussion of the application of the VTEPM to the project shorelines and fee-owned parcels in Vermont is included in the corresponding technical Phase IA survey reports. For the New Hampshire portion of the project, there are no state-level sensitivity maps or numerical ranking criteria. Therefore, the Phase IA surveys employed similar environmental/cultural factors included in regional predictive models to determine the archaeological sensitivity of the project shorelines and fee-owned parcels in New Hampshire.

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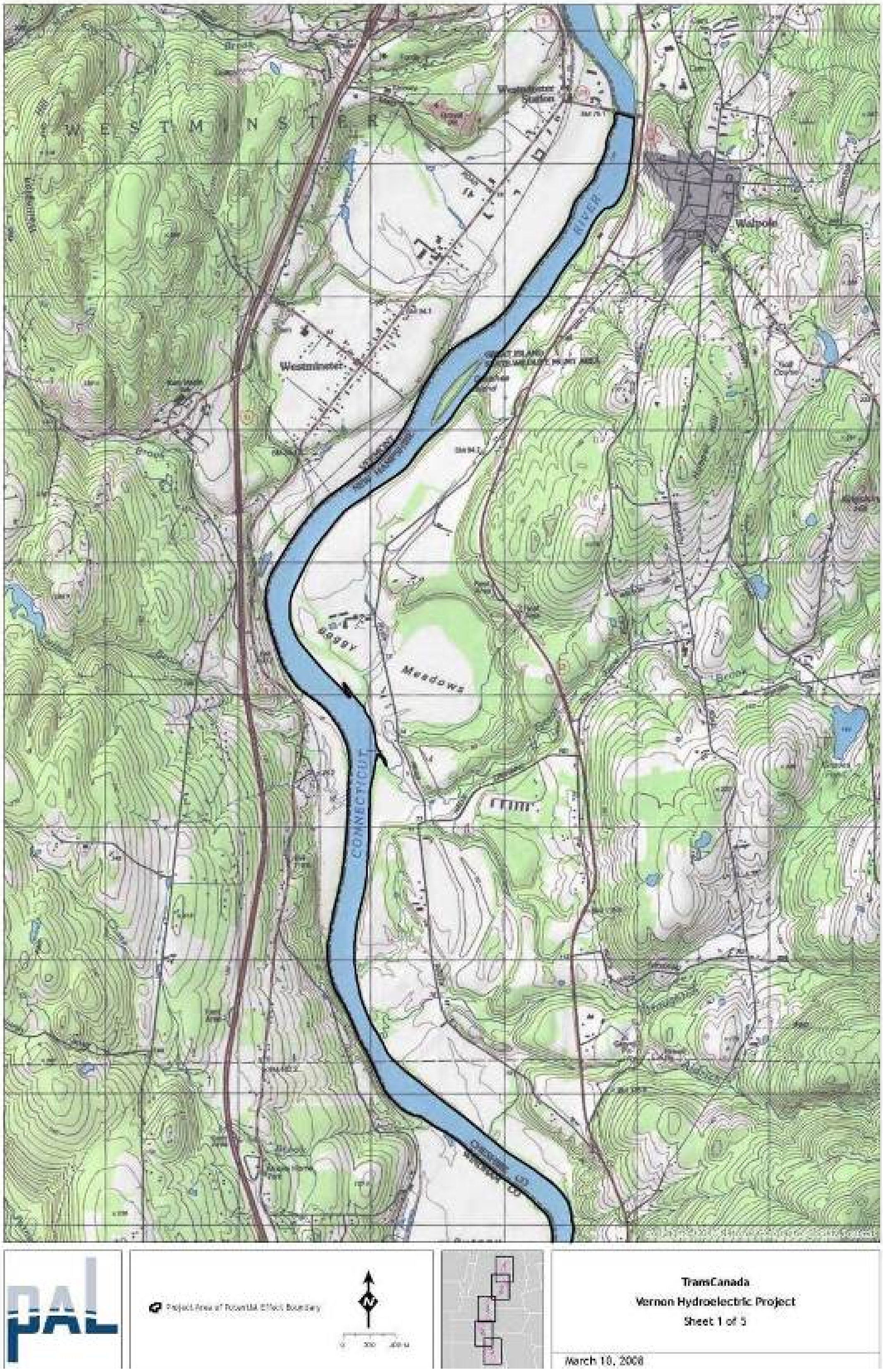
ATTACHMENT 33-B

Figures 33-1 through 33-15. Recommended APE maps

The following maps illustrate the recommended APE for each project.

The APE is defined as all land within the FERC project boundaries owned in fee simple by TransCanada and 10 meters (33 feet) of land inland from the top of bank in areas along the Connecticut River and affected portions of tributaries where TransCanada holds flowage rights.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Sheet 1 of 5
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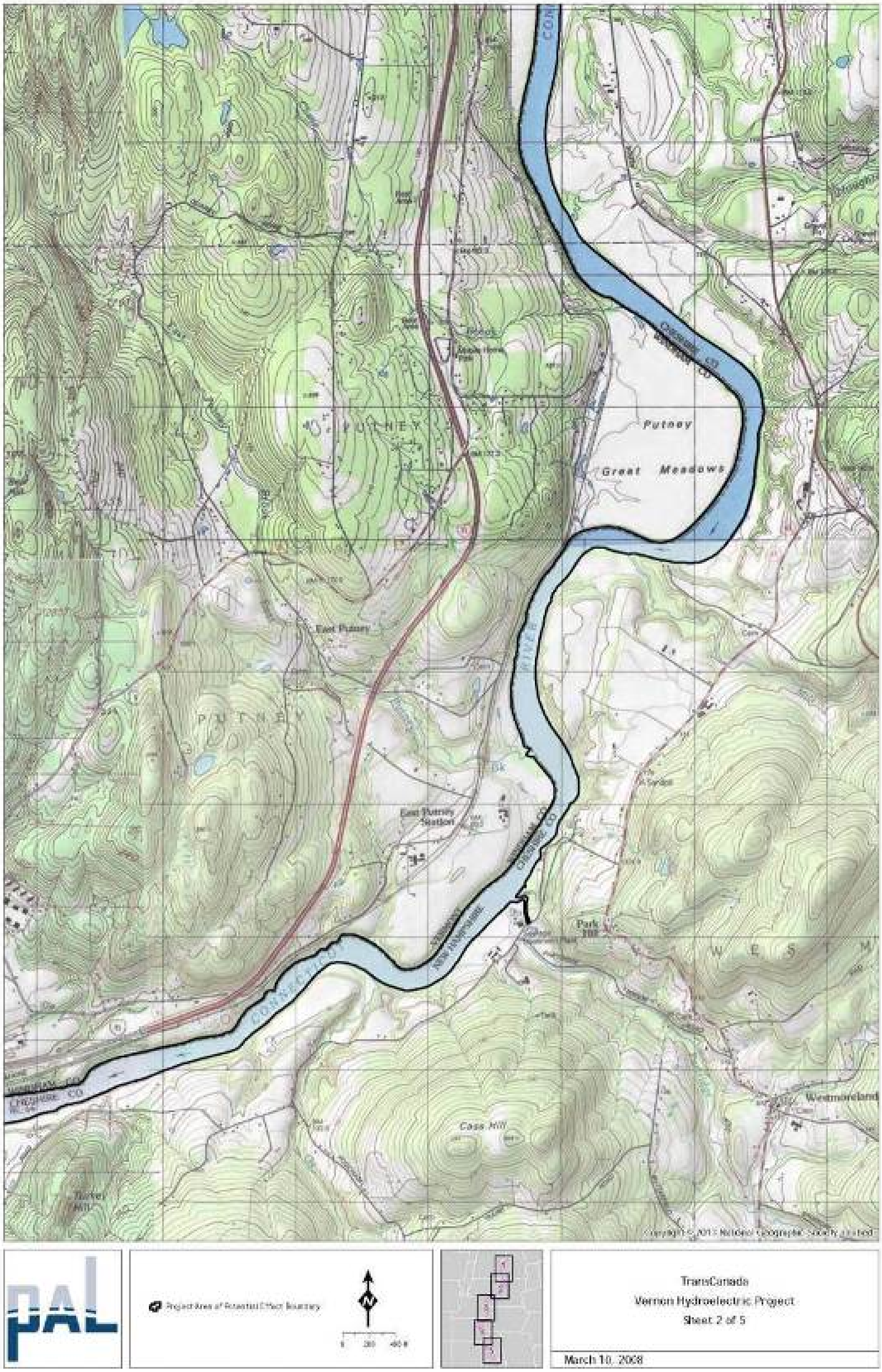
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RIVER
Park Hill
WEST
Westmoreland
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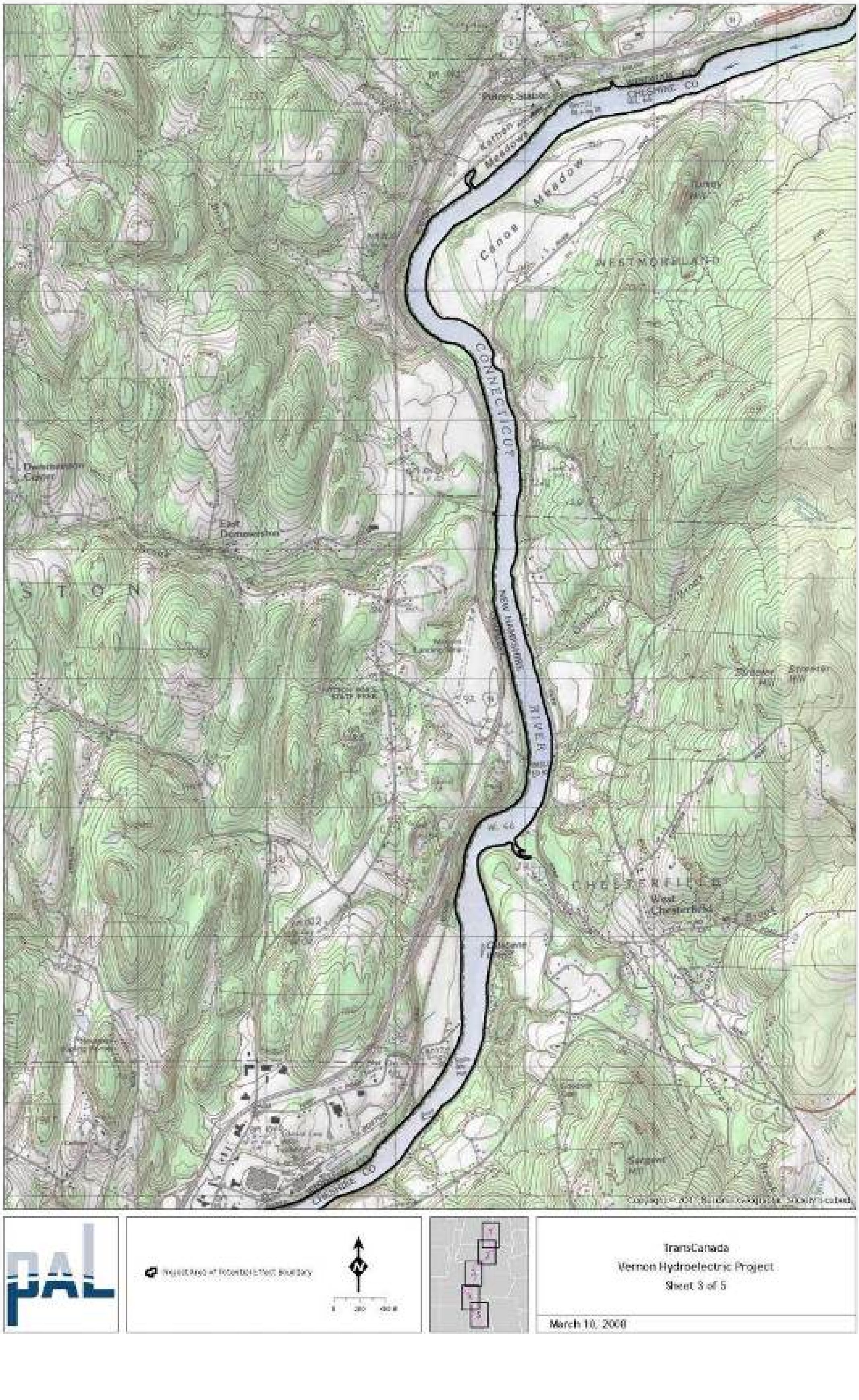
Vernon Hydroelectric Project
Sheet 2 of 5
March 10, 2008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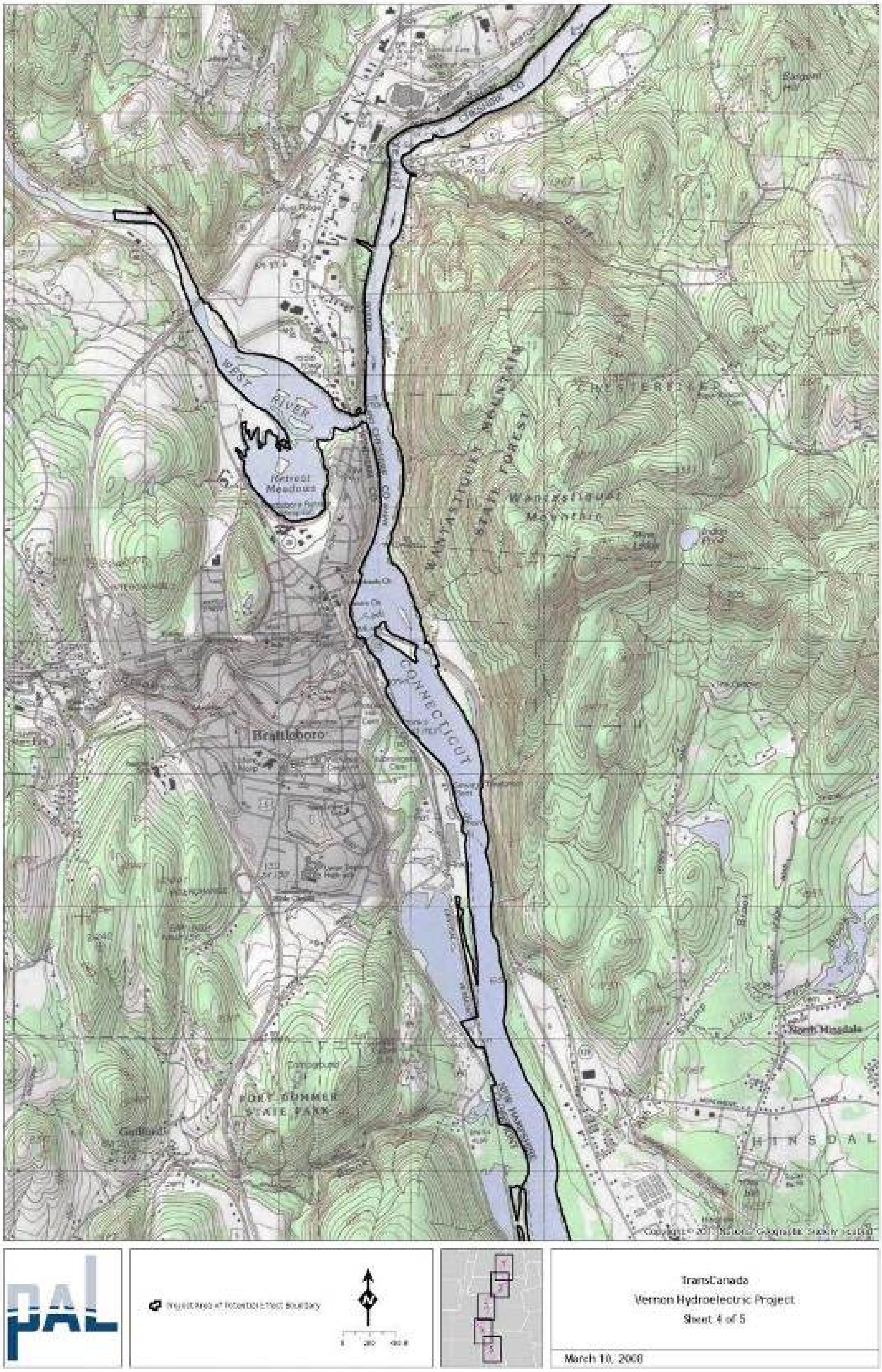
Sheet 3 of 5
March 10, 2008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Retreat Meadows
Brattleboro
CONNECTICUT
WANTASTIQUET MOUNTAIN STATE FOREST
Wantastiquet Mountain
FORT DUMMER STATE PARK
North Hinsdale
HINSDAL
TransCanada
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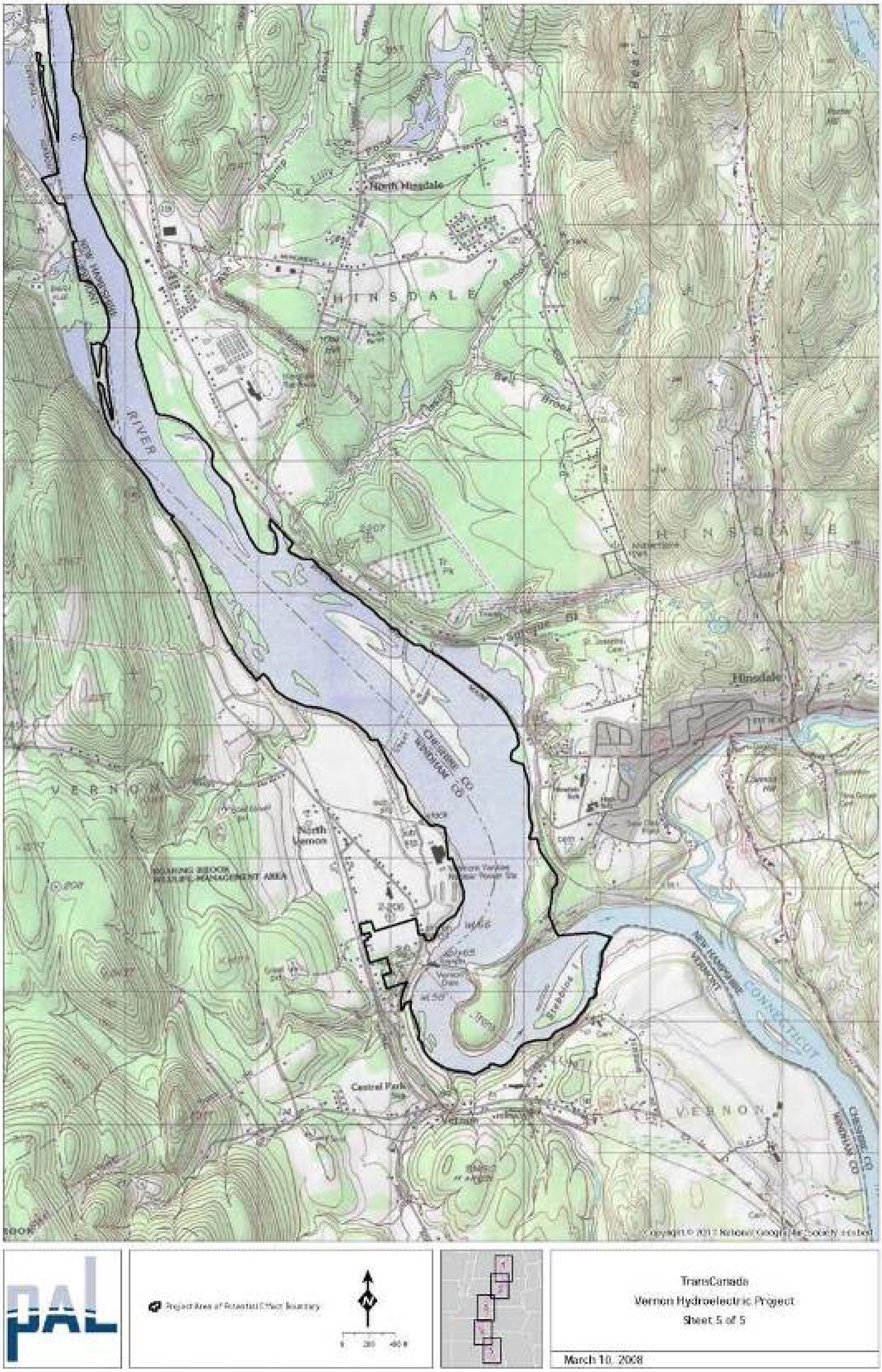
Sheet 4 of 5
March 10, 2008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Sheet 5 of 5
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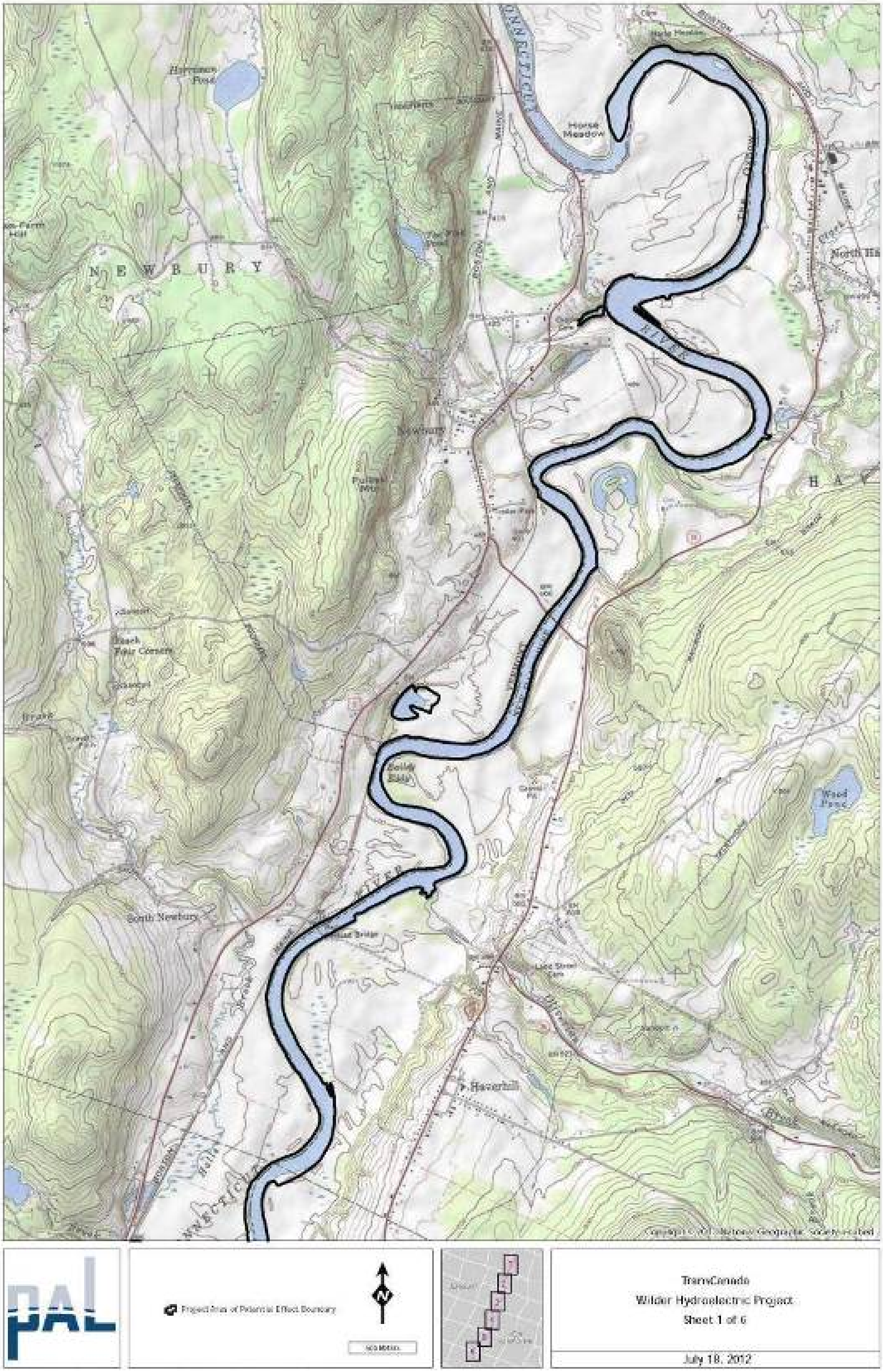
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Haverhill
Wood Pond
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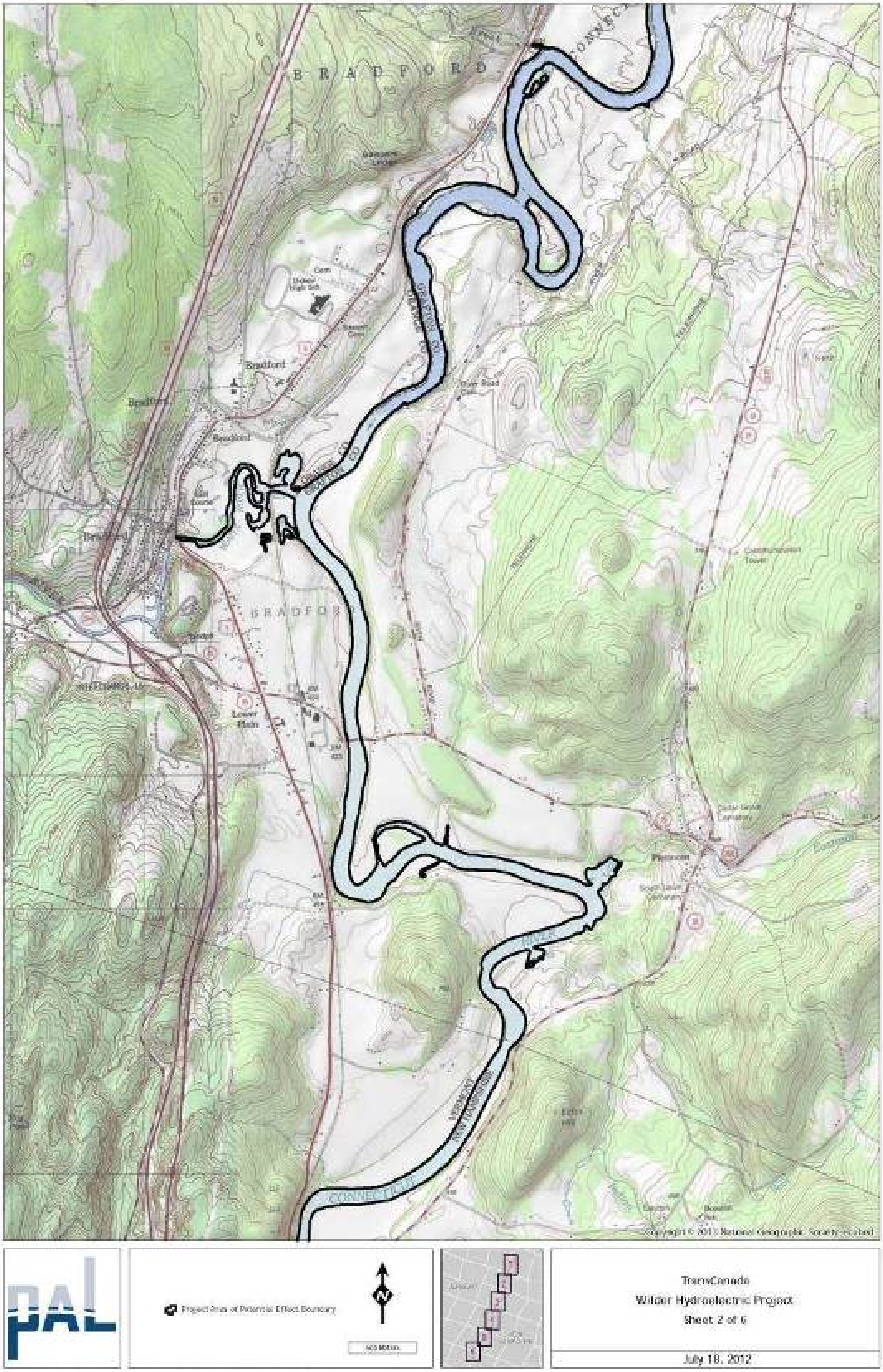
Wilder Hydroelectric Project
Sheet 1 of 6
July 18, 2012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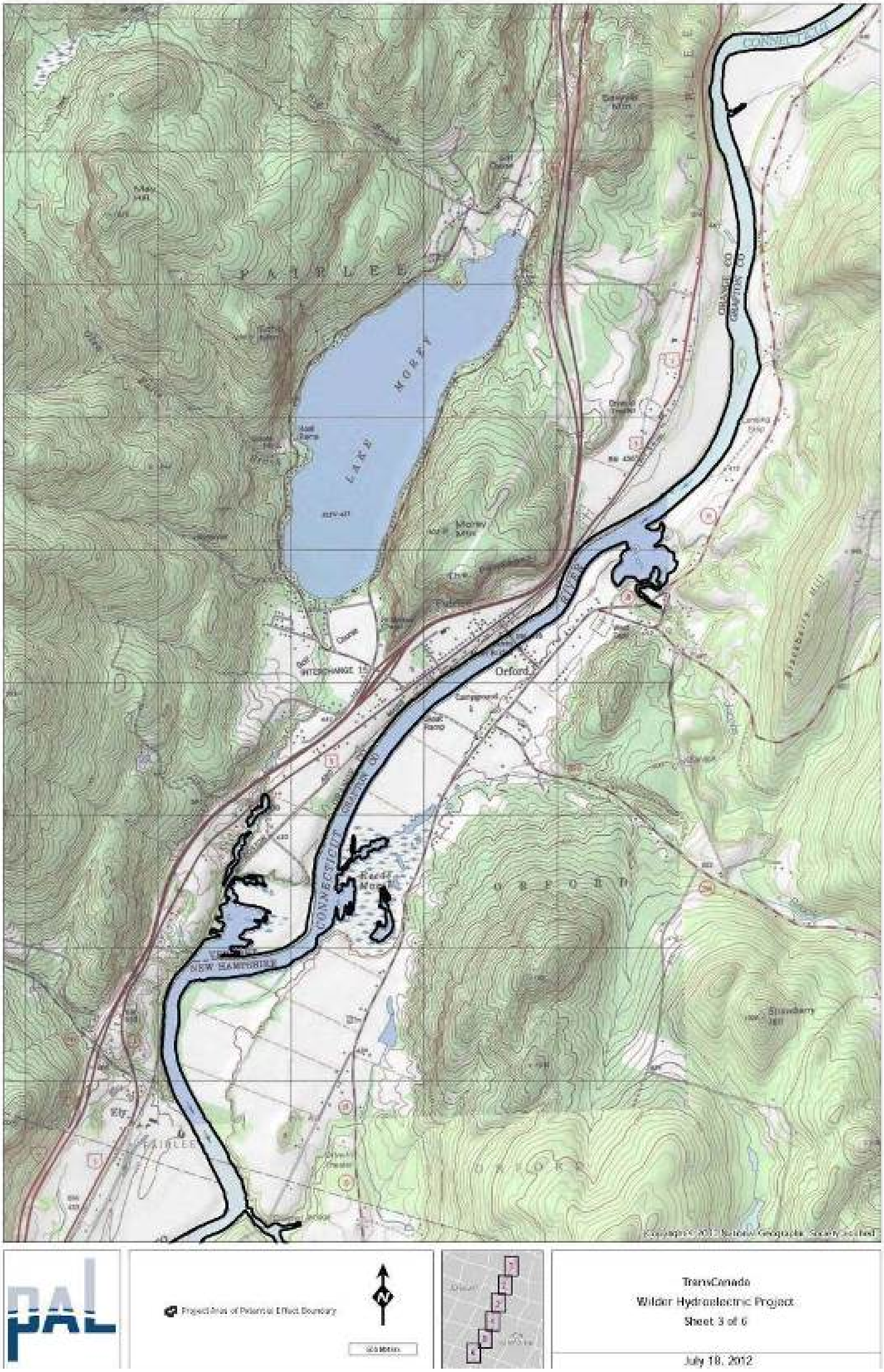
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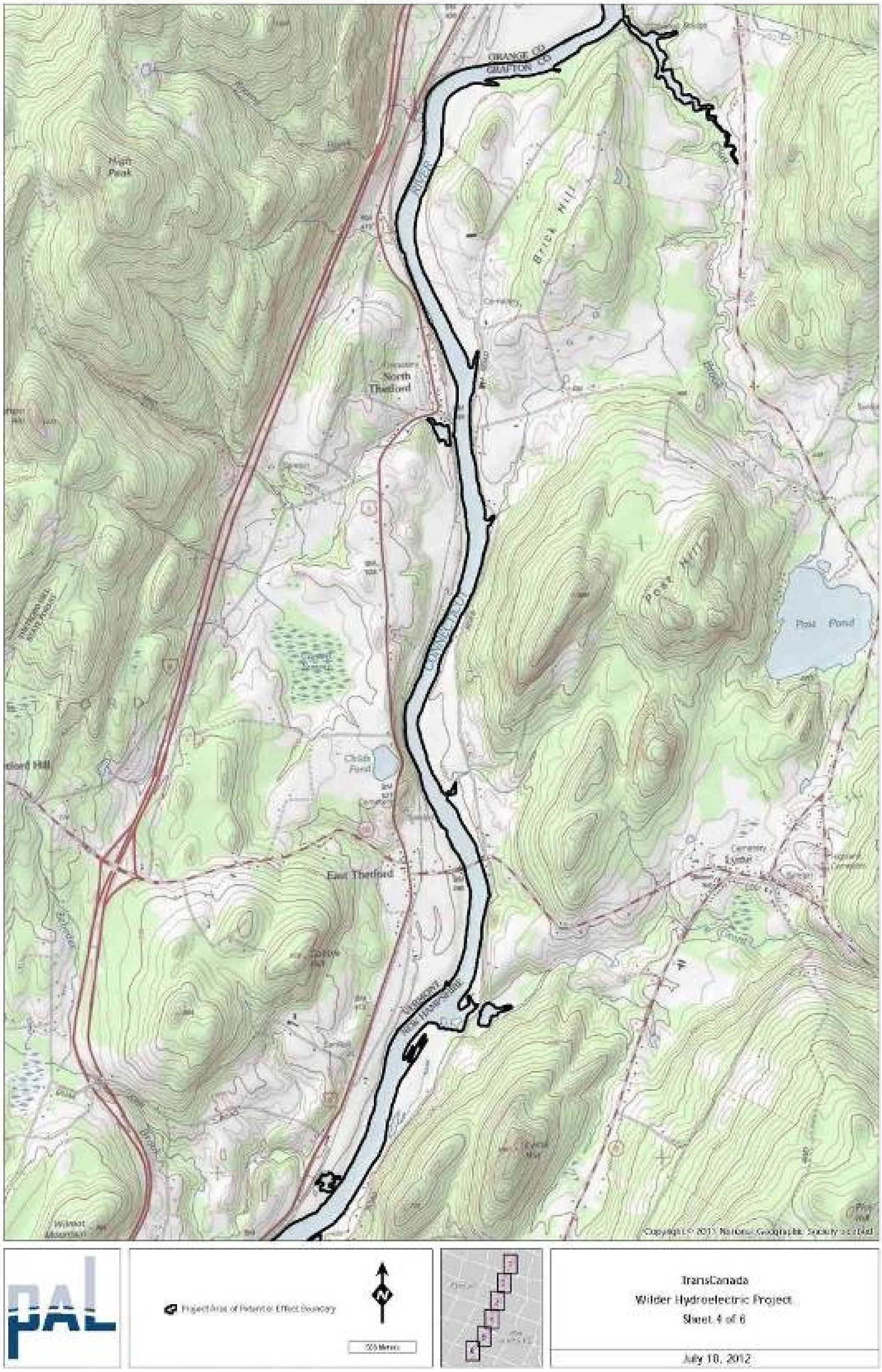
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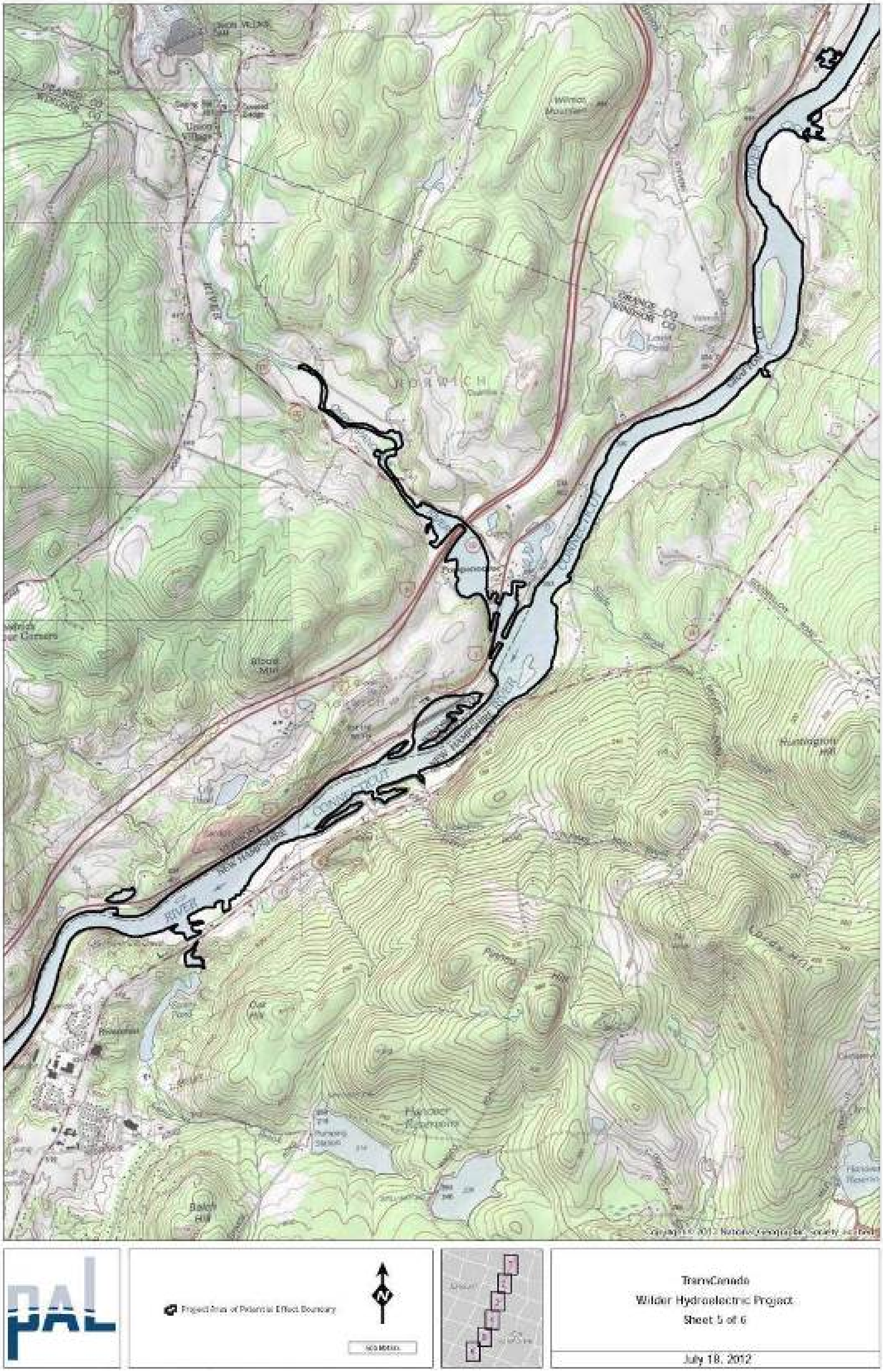
GRAFTON CO
High Peak
Brick Hill
North Thetford
Post Pond
Child Pond
East Thetford
TransCanada
Wilder Hydroelectric Project
Sheet 4 of 6
July 18, 2012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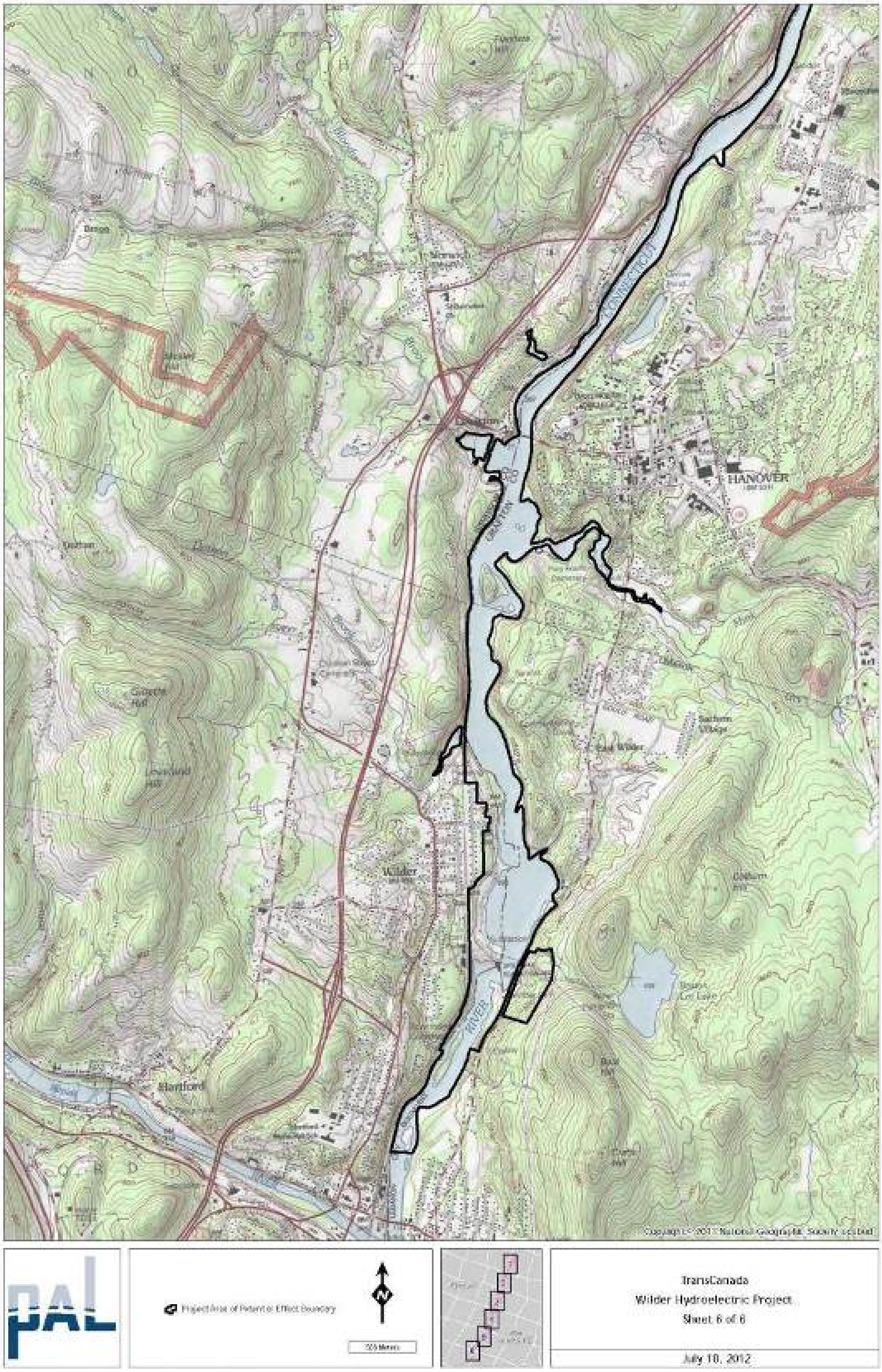
TransCanada
Wilder Hydroelectric Project
Sheet 5 of 6
July 18, 2012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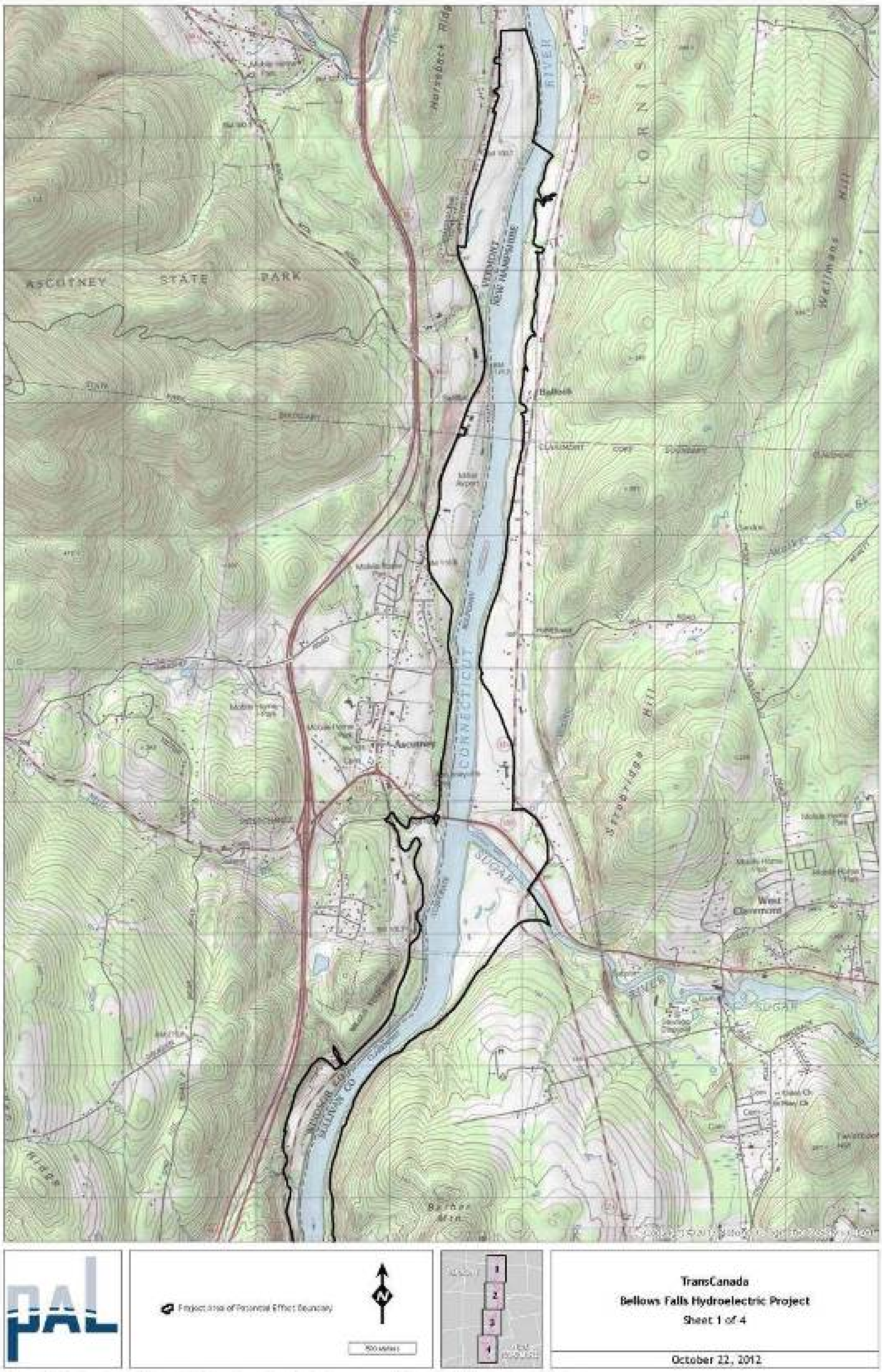
Sheet 6 of 6
July 10, 2012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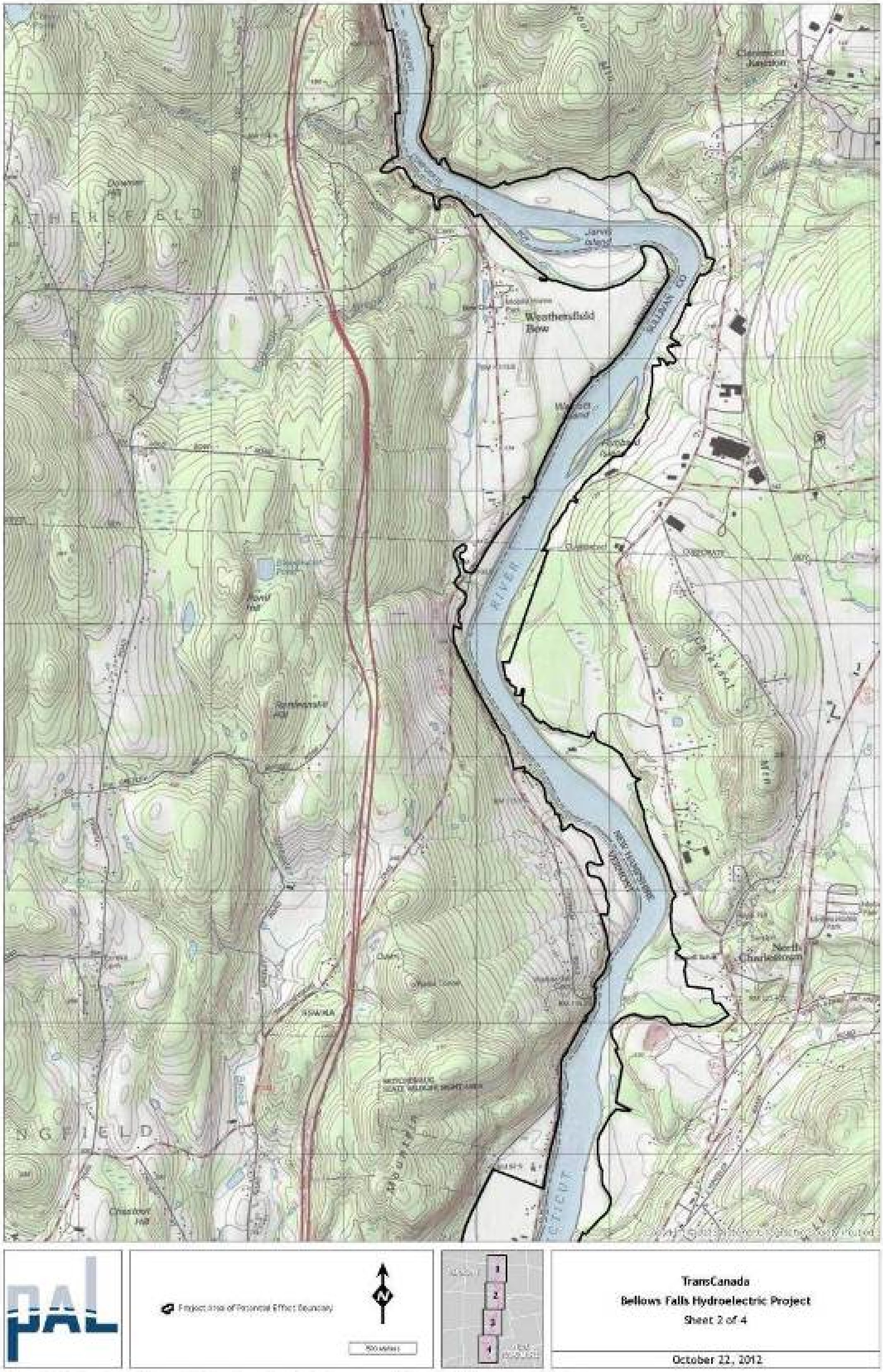
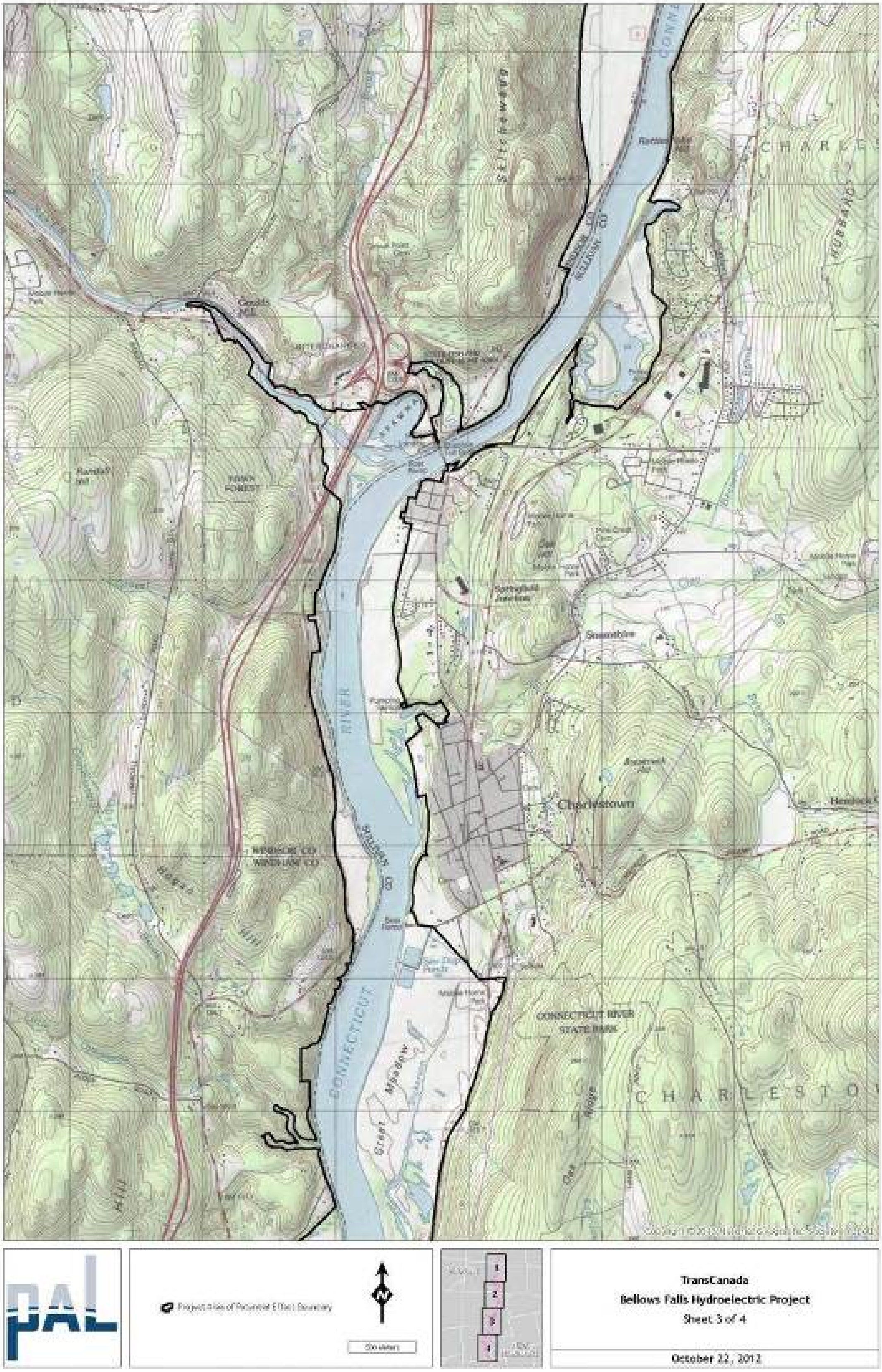
TransCanada
Bellows Falls Hydroelectric Project
Sheet 1 of 4
October 22, 2012


Project Area of Potential Effect Boundary
500 meters
TransCanada
Bellows Falls Hydroelectric Project
Sheet 2 of 4
October 22, 2012


CONNECTICUT
RIVER
Charlestown
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WINDHAM CO
Great Meadow
CHARLESTOWN
TransCanada
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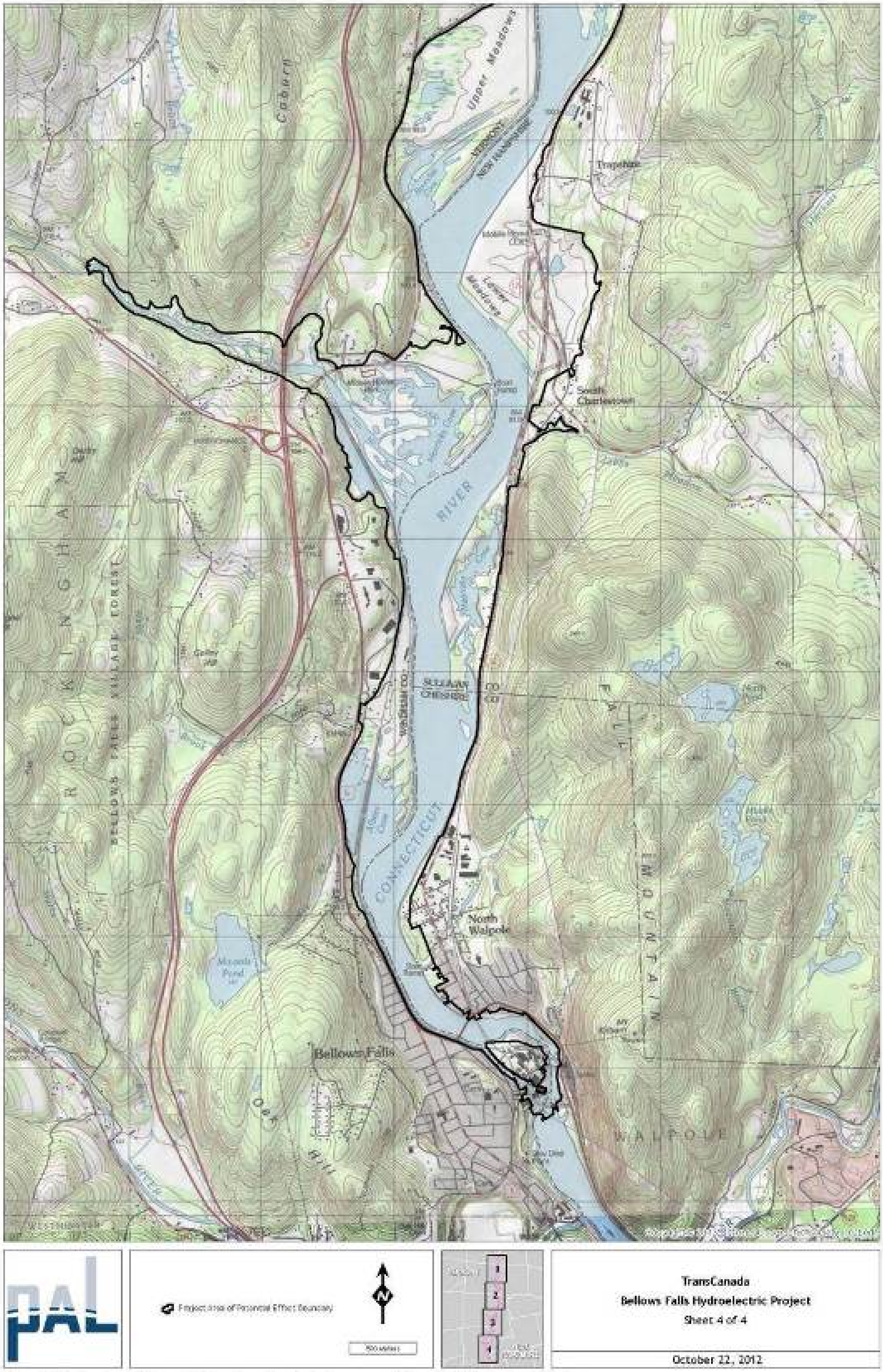
Sheet 3 of 4
October 22, 2012


RIVER
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SULLIVAN
CHESHIRE
North Walpole
Bellows Falls
WALPOLE
TransCanada
Bellows Falls Hydroelectric Project
Sheet 4 of 4
October 22, 2012

TRANSCANADA HYDRO NORTHEAST INC.

Wilder Hydroelectric Project (FERC Project No. 1892-026)
Bellows Falls Hydroelectric Project (FERC Project No. 1855-045)
Vernon Hydroelectric Project (FERC Project No. 1904-073)

Revised Study Plan

Appendix A

Study Requests Received by March 1, 2013

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List of Study Requestors

Appalachian Mountain Club, Vermont River Conservancy, and Friends of the Connecticut River Paddlers' Trail (2 letters filed)

City of Lebanon, New Hampshire Planning Office

Connecticut River Joint Commissions, Inc.

Connecticut River Watershed Council

Federal Energy Regulatory Commission

Lipfert, F. William, Jr., and Jennifer Lipfert

Mudge, John T. B.

National Park Service

New England Flow and American Whitewater (2 letters filed)

New England Flow, American Whitewater, and Appalachian Mountain Club (3 letters filed)

New Hampshire Department of Environmental Services

New Hampshire Fish and Game Department

New Hampshire Natural Heritage Bureau

The Nature Conservancy

The Nolumbeka Project, Inc.

Town of Lyme, New Hampshire Office of the Selectboard, City of Lebanon, New Hampshire City Manager, and O. Ross McIntyre (1 letter and one study plan filed)

Town of Rockingham, Vermont Conservation Commission (5 letters filed)

Trout Unlimited, Deerfield River Chapter

Trustees of Pine Park Association, Hanover New Hampshire

Two Rivers-Ottauquechee Regional Commission

U.S. Fish and Wildlife Service

Vermont Agency of Natural Resources

Vermont Division for Historic Preservation, State Historic Preservation Office

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UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

TransCanada Hydro Northeast, Inc. Bellows Falls Project No. 1855-045

APPALACHIAN MOUNTAIN CLUB, VERMONT RIVER CONSERVANCY, AND FRIENDS OF THE CONNECTICUT RIVER PADDLERS' TRAIL'S COMMENTS AND STUDY REQUESTS
IN RESPONSE TO THE
NOTICE OF INTENT TO FILE LICENSE APPLICATION, FILING OF PRE-APPLICATION DOCUMENT (PAD), COMMENCEMENT OF PRE-FILING PROCESS, AND SCOPING: REQUEST FOR COMMENTS ON THE PAD AND SCOPING DOCUMENT, AND INDENTIFICATION OF ISSUES AND ASSOCIATED STUDY REQUESTS REGARDING THE BELLOWS FALLS HYDROELECTRIC PROJECT, FERC PROJECT NO. 1855-045.

Since 1876, the Appalachian Mountain Club (AMC) has promoted the protection, enjoyment, and understanding of the mountains, forests, waters, and trails of the Appalachian region. The AMC is a steering committee member of the Hydropower Reform Coalition based in Washington, D. C. The AMC is the largest conservation and recreation organization in the Northeast with more than 90,000 members, many of whom live within three hours of the Connecticut River and would enjoy this section as a daylong or longer trip. The AMC's interests in hydropower relicensing are mainly in the areas of conservation and recreation.

The Vermont River Conservancy protects public access, wildlife habitat, clean waters, scenic natural beauty and ecological integrity by conserving undeveloped land along rivers, lakes and wetlands of Vermont. Since 1995, working in cooperation with state and federal agencies, municipalities and other conservation organizations, VRC has completed projects at over 45 popular local swimming holes, gorges and waterfalls, fishing and boating accesses, protecting paddlers' trails and meandering river corridors for all to enjoy.

The Friends of the Connecticut River Paddlers' Trail is dedicated to building and stewarding primitive campsites, access points, and portage trails along the Connecticut River. The organization manages over 30 campsites and 70 access points that reach from the Connecticut River's headwaters south to the Massachusetts border. Efforts are underway to expand the trail into Massachusetts and Connecticut. The group includes representatives from conservation organizations, state and federal agencies, hydroelectric companies, and town conservation commissions that recognize the region's rich ecology and productive working landscape and seek to facilitate recreational use compatible with the Refuge's natural, social, and historic character.

Currently five hydropower projects on the Connecticut River are up for new federal licenses, including Bellows Falls. These five facilities influence about 168 miles of the longest river in New England, including creating 91 miles of reservoir that have fragmented the river and converted whitewater rapids into impoundments. The impacts stretch from the upper reaches of the 45-mile long Wilder Project reservoir in New Hampshire and Vermont down to about Northampton, or possibly the Holyoke Dam reservoir, in Massachusetts. The watershed surrounding these projects encompasses a significant portion of the 7.2 million acres in the Connecticut River and Watershed National Blueway. The Bellows Falls section of the Connecticut River offers paddling opportunities of sufficient quality to attract national interest. The main stem is of sufficient size for canoeing, kayaking and rowing for multiple-day trips, and flows through beautiful Appalachian countryside.

Rather than repeating some requests here, the AMC co-signed onto American Whitewater and New England FLOW's study requests for whitewater recreation and contingent valuation economic studies and hereby reference them without repeating them in detail for brevity's sake. This includes controlled-flow studies as have been done on dozens of FERC projects, specifically of the whitewater reach below Bellows Falls Dam. The original riverbed of the Connecticut River in the Bellows Falls bypass reach has the ability to offer quality paddling opportunities through spillage events. This site would be a very good location to develop a whitewater park, where at moderate flows canoeists and kayakers could use the run for surfing waves and for acrobatic tricks called freestyle paddling.

On- or off-site mitigation for the loss of whitewater should also be evaluated in relation to the loss of at least five significant rapids at Wilder Dam and Bellows Falls Dam, including at least three rapids in Olcott Falls, the rapids now drowned under the reservoir at Bellows Falls, and the Bellows Falls dewatered bypass reach.

In the following study requests, we additionally address impacts of and study needs for the Bellows Falls Project, including issues of multiple-day river trips including the woeful portage trail, historical and cultural resources, and the financial health of the operator and decommissioning funds.

All studies requested here should contain projections for use by the public during the 30-year life of the proposed license, and the adequacy of all facilities and mitigation for that time period, as well as how existing impediments discourage public use currently.

The recreational use of the resources at this project has the potential to add significant economic value to the region given its central location and its proximity to Dartmouth College, Norwich University, and the communities of Bellows Falls, Springfield, and White River Jct., Vermont, as well as Lebanon, New Hampshire. Millions of people live within a three-hour drive.

In addition to recreation and aesthetics, we recognize that flow-related decisions also affect economic factors related to power generation and other environmental variables. We look forward to exploring how all flow values relate to one another through participation in this relicensing process.

Issue #1: Impacts of the Bellows Falls Dam on Multiple-Day Self-Propelled Trips on the Connecticut River.

The Bellows Falls Dam owned by TransCanada blocks the river to downstream navigation.

In the scoping area of recreation, the AMC has an interest in the creation of improved opportunities for multiple-day canoe and kayak trips on the Connecticut River, along with facilities that would also accommodate rowing shells. When compared to other regions of the country, New England generally does not have a lot of opportunities for multiple-day canoe trips with the exception of several rivers in far northern Maine, such as the St. John and Allagash, which are many hours from population centers. The Connecticut River runs from northern New Hampshire to Long Island Sound. It passes through several major population centers and is easily accessible from all the cities in New England as well as the greater New York City area with populations in the millions.

The most serious obstacles to multiple-day trips on the Connecticut River are the hydropower dams themselves. Access points and campsites are inadequate. The portage trail routes visitors along a busy state highway. A study is needed to examine the feasibility of relocating this portage trail along a safer route. Additional land-based amenities could be added such as potable water, toilets, and campsites that would be used by paddlers engaged in multiple-day trips on the river.

In preliminary application documents, the Licensee cites the New Hampshire SCORP, which identified the need for a variety of recreational opportunities. The Vermont SCORP (2005-2009) reveals the need for access to all types of outdoor recreation. Multiple-day canoe, kayak or rowing trips certainly meet the needs identified in the SCORP documents, but such trips are severely limited by the operations of the Bellows Falls hydropower dam.

Facilities such as portages, campsites, and boat ramps exist, as detailed in the PAD. But for multiple-day trips, or for paddlers or rowers seeking to navigate the length of the Connecticut River, the dams discourage such travel. Fisheries biologists have suggested that migrating fish tire after the second fish ladder. Canoeists faced with the cumulative obstacles presented by the hydropower dams become similarly discouraged and abandon their efforts to migrate downriver.

In the PAD, the Licensee proposes no enhancements to mitigate the project effects on multiple-day canoe and kayak recreational use.

Issue #2: Impacts of the Connecticut River Flow Diversion on Recreational Paddling at the Bellows Falls Bypass Reach.

The Bellows Falls project contains a .7-mile diversion that reduces in-stream flows completely except for some leakage. Any natural boatable flows under flood spillage are inaccessible, high, flashy, unpredictable, and are only available during periods of seasonal high spillage due to flooding. Near the bottom of the reach, a low-head weir was installed that might make paddling hazardous. The current operation of the project eliminates any valuable seasonal paddling opportunities.

This recreation-flow relationship would need to be substantiated through both operational analyses and recreational analyses. Controlled flow studies have been done on dozens of FERC projects. The correct context to conduct this inquiry is through the use of a controlled-flow analysis. Doug Whittaker, Bo Shelby, and John Gangemi describe the techniques for controlled-flow studies in *Flows and Recreation: A guide to studies for river professionals* (2005), p. 26-29, available from the National Park Service website at: http://www.nps.gov/hydro/flowrec.pdf

Most natural boatable flows have been eliminated because of the dam. The current operation of the project eliminates valuable seasonal paddling opportunities. In the PAD, the Licensee proposes no flow enhancement to mitigate the project's effects on whitewater recreational use.

Issue #3: The Opportunity to Create a Whitewater Park at the Bellows Falls Bypass Reach.

Many of the paddling opportunities eliminated by the project could be restored by the development of a whitewater park with moderate, stable, and predictable whitewater flows that could be used from the late spring through early fall months.

The Bellows Falls bypass reach is a prime opportunity to create a whitewater park that could be of enormous economic value to the Bellows Falls, Vt., and Walpole, N.H., communities, as well as the wider region. A professional designer of such parks—one with river engineers who have experience in constructing whitewater parks—should be hired to assess the opportunities. The power company should be required to remove the low-head weir that now serves no function under the railroad bridge at the bottom of this reach.

Issue #4: Rescuing Important Historical, Educational, and Cultural Records.

The Bellows Falls Dam has a significant historical background. The first bridge across the Connecticut was built on project lands, and there are Indian pictographs in the rocks of the bypass reach. The dam itself was constructed in 1928. The Connecticut River was known as a passage for Native Americans, then European settlers, and now modern citizens. Some villages were removed when the impoundments were created. These people had used the river for transportation, fishing, transporting furs and other commerce just as did the native population.

The AMC has an active volunteer and staff educational program, and the AMC has an interest in the educational benefits that should be provided to the public by the hydropower operators on the Connecticut River. Informational signage and kiosks at project facilities can promote education about invasive species, water flows, the history of the area, who to call with problems, and what to do to get involved. Such educational improvements should be coordinated with recreational improvements. Bellows Falls has an active historical society working to revitalize the waterfront area. There is an opportunity to partner with the society to develop interpretive material of interest to visitors.

This relicensing offers two educational opportunities that should be addressed in a study. First, the Licensee can provide assistance to visitors, schools, and river travelers to better understand the remarkable history of the Project and of the area. Second, this relicensing offers perhaps a last chance to rescue important historical records held by the Licensee related to the design and construction of the hydropower facilities, as well as historical, pre-project conditions. The study should determine what historical records remain, and make suggestions for their safe storage, for how they can be made publicly accessible, and for improvements at the projects to highlight the historical significance of the facilities to the public.

Issue #5: Economic Health and Decommissioning.

Energy markets have changed dramatically in the past decade. The ownership turnover of energy facilities has been dramatic. Climate change may cause more frequent catastrophic and extraordinary events in coming years in the Connecticut River Valley. Tropical Storm/Hurricane Irene in 2011 washed out some portion of almost every state highway in Vermont except the Interstates. With the possibilities of millennial weather events occurring with much greater frequency and the ongoing dramatic changes in the competiveness of current energy generating sources, we believe that a study should assess the need for escrowed decommissioning funds or trust funds for all hydroelectric facilities currently up for new licenses. Many outdated and derelict dam removals today are coming at the expense of public dollars.

We recommend a study to determine the appropriate decommissioning costs at the end of this project’s lifetime and how such costs should be funded in escrow in advance. In an age of international ownership, deregulation, changing ownership, and climate change, the financial health of ownership can be brought into jeopardy by distant events or by weather-related catastrophic failure of a dam. The public should not be burdened with decommissioning costs.

Study Requests

We hereby request five studies per 18 CFR 5.9(b).

1. Study of Project Facilities to Support Multiple-day Self-Powered Boating Trips on the Connecticut River.

(1) Describe the goals and objectives of each study proposal and the information to be obtained.

We recommend a study of the quantity, quality, and adequacy of land-based recreational facilities operated by the Bellows Falls Licensee that are associated with boating on the Connecticut River. This study should examine put-in and take-out facilities especially for canoes, kayaks, rowing shells and other self-powered watercraft; portage routes; campsites; parking and road access; seasons of operation of the facilities to match with actual river use; maintenance; water supplies and other amenities at campsites; and trash and sanitary facilities. The study should include a projection of usage during the proposed 30-year life of the license, and opportunities for the Licensee to buy land from willing sellers in order to increase and safeguard recreational benefits for the project's tenure.

The study should examine the facilities that are necessary specifically for canoe, kayak and rowing shell access to the river. Information from the state SCORP studies and from other river recreational interests suggests that interest in quiet water paddling is rising along with the sales of sea kayaks, rowing shells and canoes. Most of the existing facilities in the Bellows Falls region were designed for day use by motorboats. Motorboat launch ramps are not particularly suited to canoeists, especially those using wood-and-canvas or fiberglass canoes (e.g., sand works better than concrete).

Paddlers who have attempted to follow the Connecticut River to the sea report that portages and camping can be difficult. Campsites are few and far between. Islands are often posted as off-limits. Campsites can often be overcrowded and a recent study by the Connecticut River Paddlers' Trail documented their poor condition. The study found that the existing campsite above the Bellows Falls impoundment (Lower Meadow Campground) lacks safe river access.

Competition for campsites is not uncommon, and the study might look at ways to minimize such conflicts. The Connecticut River Paddlers' Trail organization states the ideal frequency of canoe campsites is one for every five river miles, accompanied by canoe and kayak access in every town. Current facilities don't meet that standard.

The portage trail at Bellows Falls could be significantly improved. The portage is currently 1.5 miles long, and for most of that distance follows the breakdown lane of a high-speed state highway, New Hampshire Route 12. The guidebook to the river suggests that TransCanada can send a truck to pick up paddlers, but the Licensee no longer does that. Jeff Feldman from Hartford, Conn., who has paddled all 410 river miles in one-week stages over five years, said, "People were pretty in awe when they saw four guys and a dog with two canoes. The only part that was really dangerous was where the sidewalk ended and we had to stay in the road." Trucks and cars create gusts of wind as they pass, which threaten to pull paddlers and boats onto the highway. There have to be better options.

Bellows Falls portage trail along N.H. Route 12 (Photo: Jeff Feldman)

Trails on both land and water should be studied. The Connecticut River Paddlers' Trail and the Connecticut River Birding Trail cross several project boundaries. Their interests should be part of a study framework that takes a watershed viewpoint, especially as it involves trail networks and associated facilities.

The ownership of project lands at all the facilities should be studied for recreational and conservation improvements. Some project lands could be added to existing park facilities, or placed under permanent conservation restrictions, in order to improve conservation and recreation. One example includes project lands near the Herrick's Cove Park in Rockingham, Vt., which is part of the Bellows Falls Project.

The public has an interest in trails in the vicinity of project lands. The study should evaluate the adequacy and maintenance of existing trail systems for the next 30 years, and determine opportunities for additional hiking trails on project lands, and for linking those trails to existing trails. Such trails in the watershed could cross project boundaries, and adding to them could involve requiring the Licensee to purchase additional land.

In association with this study, the creation of the Connecticut River and Watershed National Blueway should be taken into account, along with ways that the Bellows Falls Project can contribute to that effort. The study should take into consideration impacts on the entire watershed.

As part of this study, for example, a survey should seek to determine why people do NOT use this great public resource in the Bellows Falls reach. The cumulative discouragement of recreation on the Connecticut River may displace users to other areas of the watershed. As with upstream migration of fish and downstream migration of canoeists, the survey might identify several discouraging aspects of project operations that could be corrected during relicensing.

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;

None of the three requesters is a resource agency. However, several state and federal agencies have an interest in recreation and conservation on the Connecticut River.

The Connecticut River Joint Commissions, created by the legislatures of Vermont and New Hampshire in the late 1980s, is directed to cooperate with each other to preserve and protect the resources of the Connecticut River Valley, and to guide its growth and development. In 2009, CRJC's five local river subcommittees completed a major update of their recreation plan for the river region. The study is aligned with several of the headwaters subgroup’s top ten priorities, which aim to:

- Encourage protection of open space for public recreation and scenic views. *Towns should take advantage of opportunities to conserve riverfront land for public access, trails, birding, or other recreation. Land conservation organizations should help protect scenic views and open space, especially along the river, providing public recreation access for birding, car-top boats or trails.*
- Provide more primitive camping opportunities. *Parks and recreation agencies should help recreation groups and local volunteers to establish and coordinate a new water trail of dispersed primitive canoe campsites in the region to help prevent trespassing and disperse camping impacts.*

The states of Vermont and New Hampshire manage recreational sites in the vicinity of the TransCanada facilities. There is a clear interest in the public’s ability to traverse the Connecticut River in boats. The Connecticut River Atlantic Salmon Commission (CRASC), the Vermont Department of Fish & Wildlife (VT-F&W), the U. S. Fish & Wildlife Service (USF&W), and the National Marine Fisheries Service (NMFS) have a clear interest in the passage of anadromous and other migratory fish including shad, blue-back herring, eels and other species through fish ladders at the Bellows Falls Dam.

Beyond the fisheries agencies, several federal agencies have an interest in recreation and conservation on the Connecticut River. On May 24, 2012, Secretary of the Interior Ken Salazar designated the Connecticut River and Watershed as the nation’s first National

Blueway. A Memorandum of Understanding signed in August 2012 by the departments of Interior, Agriculture, and the Army has as one objective “providing opportunities for scientific research, environmental education and outdoor recreation and access within the National Blueway to the extent compatible with agency missions.” The National Blueway concept takes a watershed viewpoint and addresses the river from its source to the sea. The National Blueways System has as its goal “to advance a whole river and watershed-wide approach to conservation, outdoor recreation, education, and sustainable economic opportunities in the watersheds in which we live, work, and play.” The National Blueway designation includes all the tributaries in the watershed and involves several federal and state agencies, including the U.S. Army Corps of Engineers, the Silvio Conte Refuge, U.S. Fish and Wildlife Service, the National Park Service, and the States of Connecticut, Vermont, New Hampshire, and the Commonwealth of Massachusetts, which have prioritized conservation, recreation, and restoration in the 7.2 million-acre Connecticut River Watershed.

(3) If the requester is a not resource agency, explain any relevant public interest considerations in regard to the proposed study.

The Bellows Falls dam on the Connecticut River creates obstacles to public navigation and recreation on the river. Conducting the necessary studies and implementing the measures needed to ensure the public has access to quality outdoor recreational resources are in the public interest. It is widely accepted that outdoor recreation has significant benefits to participants including health, well being, and quality-of-life. Outdoor recreation also has proven economic benefits for communities located near recreational resources.

Improvement in opportunities for multiple-day canoe, kayak and rowing trips on the Connecticut River has the potential to offer the region significant economic benefits.

Project operations have created serious aesthetic issues along the route of the Connecticut River. The dry bypass reach at Bellows Falls is an aesthetic sore spot on the river. Even worse, the dam substitutes its industrial appearance for the naturally scenic rapids and falls that graced the Connecticut River at Bellows Falls. The public has an interest in the scenic values of this major public resource.

(4) Describe existing information concerning the subject of the study proposal, and the need for additional information.

There is an inconsistent body of knowledge regarding multiple-day trips on the Connecticut River. The PAD produced by the Licensee lists many facilities that are not owned or operated by the Licensee, including commercial operations that may have a brief lifespan. There is a lack of consistency about those facilities in terms of their seasons of use and what amenities exist for public recreational use and their long-term protection.

Several publications are widely used by paddlers and recreationalists. The primary source of information is *The Connecticut River Boating Guide: Source to Sea* (3rd ed.) published by the Connecticut River Watershed Council (2007). Recreational maps and guides to the river have been published for some reaches by KM Digital Productions in South Hadley, Mass., and are available from the Connecticut River Watershed Council. These foldout river maps cover the reaches from Bellows Falls to Vernon, Vt. (2011), and from Vernon, Vt., to Turners Falls, Mass. (2008). Most of those maps are in need of updates. In 1991, New England Cartographics in Amherst, Mass., published the *Connecticut River Guide in Massachusetts* by Doug Greenfield and Christopher J. Ryan. The Connecticut River Birding Trail organization located in White River Junction, Vt., has published maps detailing the upper valley section, the northern section, and the southern section of the river.

The Connecticut River Paddlers' Trail organization has a report that assesses the quality of campsites. Noah Pollock of the Vermont River Conservancy prepared a site assessment and recommendations for the power company titled *TransCanada Hydro Northeast Connecticut River Paddlers' Trail Campsites*. The undated report examined campsites at Vernon and Bellows Falls and concluded that most were in "fair to good shape." Incidentally, the report also exposes the inconsistency and lack of maintenance at the project campsites. In 2013, the organization also published a Connecticut River Paddlers' Trail map of the river.

The Connecticut River Joint Commissions updated the Recreation Chapter of the Connecticut River Corridor Management Plan recently — there are six volumes, all posted online at: http://www.crjc.org/river-plan/recreation-management-plan/ The Upper Valley, Mount Ascutney and Wantastiquet plans will be most relevant as they each contain a section on boating for that section of the river.

(5) Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

The Bellows Falls Dam prevents navigation downstream on the main stem of the Connecticut River. Project owners have a responsibility to the public to provide adequate portage trails and facilities that promote public recreation on the river, including access points and campgrounds with necessary amenities. This study will be the defining mechanism for identifying additional sites that can best be adapted for increasing public access and multiple-day paddling trips on the Connecticut River. License requirements may include having the Licensee purchase additional property to provide camping, trail sites, portages or other facilities to assist the public.

The study may also identify indirect effects if the hydropower facilities and their projects have discouraged public use of the Connecticut River or displaced recreation to other parts of the watershed.

Cumulative effects need to be studied because it appears that the number of dams on the river discourages multiple-day trips and has fragmented the recreational experience. This study may result in license requirements or other mitigation for the Licensee regarding multiple-day trips on the Connecticut River.

(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

Studies of the adequacy of public resources are fairly standard in the planning field. Methodologies can be selected from among the recognized and accepted standards of the resource and public planning fields. Surveys of people who do NOT use the river or are displaced can employ randomized samples from several databases. Sufficient information is available from the guidebooks and maps of the river that identify access points and campsites, as well as information contained in the PAD. The sites evaluated should be operated or funded by the Licensee, not by others. Once a consultant is selected and approved, the information should be gathered and analyzed in a timely manner. The study would probably need a summer field season to locate river users for an adequate sample. A consultant with experience in similar projects should be selected, in part to create relevant comparisons to other hydropower projects around the country.

The AMC has some staff expertise in this area because it operates facilities in the White Mountains, in Maine, and elsewhere in its chapters. We will work with the Licensee to document the known information regarding the river. We will provide volunteers and technical support for the studies when possible as appropriate. We hope to work collaboratively with the Licensee on this study.

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

There are several sites along the Connecticut River, private and public, that are used as access points or have camping facilities. However, there are vast differences in the ability or capacity of these sites to handle paddling groups with varying sizes or sanitation needs. Because there is no comprehensive guide or text that provides updated information, field inspection of existing sites should take place. Any needed reconstruction or rehabilitation of existing facilities should be identified. This analysis can be completed during any spring, summer, or fall field season.

Such field research needs to be matched with projections of use in the future and with standard requirements for access sites, campsites, portages, sanitation facilities and other amenities. We know of no other method to acquire this information for evaluation.

2. Controlled Whitewater Flow Study in the Bypass Reach below the Bellows Falls Dam.

(1) Describe the goals and objectives of each study proposal and the information to be obtained.

As stated in the American Whitewater and New England FLOW study requests, the goal of a whitewater flow study is to assess the presence, quality, access needs, flow information needs, and preferred flow ranges for river-based boating resources in a stepwise manner. The information to be obtained can be generally characterized as quantitative and qualitative descriptions of:

- The range of optimal and acceptable flows for whitewater paddling in a whitewater park setting;
- The frequency, timing, duration and predictability of optimal and acceptable paddling flows under current conditions and how proposed alternative operations could be used in a whitewater park (Note: the bypass reach currently has no minimum flow);
- The access needs of whitewater boating use and the current and potential river access options for a whitewater park and other paddling;
- The flow information needs of whitewater boating and the current and potential flow information distribution system;
- The location, challenge, and other recreational attributes associated with specific rapids and other river features in the development of a whitewater park.

Thus, the information to be obtained for the whitewater park study is a combination of user-generated flow preferences and other engineering information on current and proposed operations (e.g., discharges), geographic information and basic recreational information.

In simpler terms, the Bellows Falls Dam would release prescribed flows into the bypass reach for this test, perhaps over two days. For each release, a selected group of paddlers would run the rapid and then answer written questions about their experiences at that flow level. The Bellows Falls Dam would release several different flows, measured in cubic feet per second, and the paddlers' experiences would be analyzed to determine the flows that work best at the rapid.

The goals include evaluating this stretch of river for use as a whitewater park, and evaluating the flows at which the run could best be utilized. In this case, river engineers with experience constructing whitewater parks, such as the McLaughlin Whitewater Design Group of Denver, Colo., should participate in designing the controlled-flow study.

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.

None of the three requesters is a resource agency.

The Licensee owns and operates several river access areas on the Connecticut River within project boundaries, and the states of Vermont and New Hampshire manage additional sites in the vicinity of the Project. There is a clear interest in the public's ability to traverse the Connecticut River in boats. In addition to this interest the Connecticut River has been designated as America's first National Blueway.

On May 24, 2012, Secretary of the Interior Ken Salazar designated the Connecticut River and Watershed as the nation's first National Blueway. A Memorandum of Understanding signed in August 2012 by the departments of Interior, Agriculture, and the Army has as one objective "providing opportunities for scientific research, environmental education and outdoor recreation and access within the National Blueway to the extent compatible with agency missions." The National Blueway concept takes a watershed viewpoint and addresses the river from its source to the sea. The National Blueways System has as its goal "to advance a whole river and watershed-wide approach to conservation, outdoor recreation, education, and sustainable economic opportunities in the watersheds in which we live, work, and play." The National Blueway designation includes all the tributaries in the watershed and involves several federal and state agencies, including the U.S. Army Corps of Engineers, the Silvio Conte Refuge, U.S. Fish and Wildlife Service, the National Park Service, and the States of Connecticut, Vermont, New Hampshire, and the Commonwealth of Massachusetts, which have prioritized conservation, recreation, and restoration in the 7.2 million-acre Connecticut River Watershed.

The Connecticut River Atlantic Salmon Commission (CRASC), the Vermont Department of Fish & Wildlife (VT-F&W), the U. S. Fish & Wildlife Service (USF&W), and the National Marine Fisheries Service (NMFS) have a clear interest in the passage of anadromous and other migratory fish including shad, blue-back herring, eels and other species through fish ladders at Bellows Falls Dam. Although the federal Atlantic Salmon Restoration Program has been recently curtailed, some of the above agencies continue to study and promote the effective upstream and downstream passage of many endangered or threatened species. The State of New Hampshire, however, has terminated its salmon restoration program. This reach of the river is in New Hampshire.

(3) If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.

The Bellows Falls bypass reach offers the public an opportunity to enjoy a high quality whitewater boating resource. Conducting the necessary studies and implementing the measures needed to ensure the public has access to high quality outdoor recreational resources are in the public interest. It is widely accepted that outdoor recreation has significant benefits to participants including health, well being, and quality-of-life. Outdoor recreation also has proven economic benefits for communities located near recreational resources.

Restoration of recreation opportunities in this de-watered stretch of the Connecticut River has the potential to offer the region significant economic benefits as well as aesthetic benefits. Dryways are ugly. A woman from nearby Walpole who commented at the scoping hearing said this section of Bellows Falls had become a "sad human landscape—shabby." She said there was lots of potential in the reach, both recreationally and historically. This portion of the Connecticut River contained Hale's first bridge across the Connecticut in the 1700s, and the long history of Native American use is evidenced by pictographs on both sides of the natural riverbed below the Vilas Bridge.

FERC has concluded that *"to fully evaluate the project's effect on whitewater recreation opportunities and to balance potential enhancement opportunities with their cost, a controlled-flow whitewater boating study is relevant to Commission's public interest determination."* This is equally true regarding the Bellows Falls Project on the Connecticut River.

(4) Describe existing information concerning the subject of the study proposal, and need for additional information.

While many controlled-flow studies as described above have been conducted on New England's rivers (Deerfield, Kennebec, Rapid), this section of the Connecticut River is never used. The potential for developing a new, high quality whitewater run as a recreational facility should not be ignored.

Current and historic project operations, however, provide no meaningful information and have virtually eliminated all stable, low and moderate flows from this reach. The result has been flows too low to paddle, or flashy, spiking flows on the order of 50,000 cfs. Intermediate paddlers, commercial paddlers, and general river-runners know little about this river bypass reach under any flow conditions.

Doug Whittaker, Bo Shelby, and John Gangemi describe the techniques for controlled-flow studies in *Flows and Recreation: A guide to studies for river professionals* (2005), p. 26-29, available from the National Park Service website at:

http://www.nps.gov/hydro/flowrec.pdf

(5) Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

The Bellows Falls diversion project controls the entire flow in the Connecticut River with the exception of releasing the *"required minimum flow of 1,083 cfs or inflow, whichever is less*" into the main stem river, when generating, or during floods. The bypass reach has no minimum flow, but there is leakage from the dam into the natural riverbed. The result is the virtual elimination of valuable and regionally needed summer paddling opportunities in the bypass reach. The Connecticut River can be a high-quality paddling resource, and since paddling is a flow-dependent activity, the project directly affects paddling on the Connecticut River. The project nexus is direct.

Results of this study may produce evidence supporting mitigating license requirements for scheduled releases in the bypass reach.

(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

We request a whitewater study of the Bellows Falls bypass reach of the Connecticut River. It should follow the standard methodology of a controlled-flow study as described in Whittaker et al., cited above. This methodology is designed to gather information to assess the presence, quality, and preferred flow ranges for river-based boating resources in a step-wise manner. The process steps are generally 1) desktop analyses, 2) on-land feasibility assessment, 3) on-water single flow assessment, 4) on-water multiple flow assessment.

Bellows Falls bypass reach, October 2012. Viewed from the dam.

Bellows Falls lower bypass reach, high flows, May 1940.

Because the quality of the resource and the flow needs are unknown, we request an on-water multiple flow assessment be conducted. These studies will need to take place on various and variable dates throughout a spring and summer. Spring dates are needed to capture moderate to high flows, while late spring and summer dates afford the opportunity for scheduled lower flow releases.

We will work with the Licensee, as we have in the past, to document the known information regarding the river. The AMC and other paddling groups can provide volunteer paddlers and technical support for the studies as appropriate. We hope to work collaboratively with the Licensee on this study. The whitewater boating study methodology we have requested has been used on dozens of other FERC regulated rivers, including other studies done in conjunction with New England Power whose projects are now owned by TransCanada.

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

The Appalachian Mountain Club is willing to work with the Licensee on the whitewater paddling controlled-flow study to keep costs reasonable and the quality of information high. Any information that is already known can jump-start the study process and avoid un-needed effort. What will be subsequently needed is the integration of this information and then an organized flow study during which several flows are paddled by boaters, with still image and video documentation, surveys of the boaters, a guided conversation among the boaters, and subsequently a written report.

Some preliminary work is needed. This is a bypass reach with limited access and relatively unknown hydrology. Prior to conducting paddling runs in the bypass reach, we recommend that the Licensee remove the small low-head weir at the base of the run and restore the natural shape of the river in consultation with whitewater engineers. The collaborative approach sought by the paddling community including in-kind contributions of time and expertise should help consultants complete these studies on behalf of the Licensee for a reasonable cost.

The Licensee PAD proposes no whitewater feasibility analysis. This no-action step will reveal nothing about project impacts on whitewater recreation or opportunities for protection, mitigation, or enhancement measures. We currently do not know the relationship between specific low and moderate flows and the paddling experiences they provide. A desktop analysis cannot generate this information. Without this information we cannot fully define the project impacts, nor propose and consider provision of releases that provide targeted recreational experiences.

Lowest portion of Bellows Falls bypass reach at low water below Vilas Bridge, 2012.

3. Study of the Potential to Create a Whitewater Park in the Bellows Falls Bypass Reach.

(1) Describe the goals and objectives of each study proposal and the information to be obtained.

The goals include evaluating this stretch of river for use as a whitewater park, and evaluating the flows at which the run could best be utilized.

In this case, river engineers with experience constructing whitewater parks, such as the McLaughlin Whitewater Design Group of Denver, Colo., should examine the reach and determine its potential. The same engineers might participate in designing the controlled-flow study requested above.

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.

None of the three requesters is a resource agency. The National Park Service may have an interest in a whitewater park at Bellows Falls. We do not know of the specific interests of other state and federal agencies in designing a whitewater park.

(3) If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.

The Bellows Falls bypass reach offers the public an opportunity to enjoy a high quality whitewater boating resource with the development of a whitewater park. Conducting the necessary studies and implementing the measures needed to ensure the public has access to high quality outdoor recreational resources are in the public interest. It is widely accepted that outdoor recreation has significant benefits to participants including health, well being, and quality-of-life. Outdoor recreation also has proven economic benefits for communities located near recreational resources.

Restoration of recreation opportunities in this de-watered stretch of the Connecticut River has the potential to offer the region significant economic benefits as well as aesthetic benefits. Renewing this bypass reach and the surroundings would fit with the goals of the towns of Bellows Falls and Walpole. This portion of the Connecticut River contained Hale’s first bridge across the Connecticut in the 1700s, and the long history of Native American use is evidenced by pictographs on both sides of the natural riverbed below the Vilas Bridge. Considerable economic benefits could rise from a whitewater park.

(4) Describe existing information concerning the subject of the study proposal, and need for additional information.

The potential for developing a new, high quality whitewater park as a recreational facility should not be ignored. This is a new idea that has not been studied in the Bellows Falls area in the past.

Current and historic project operations provide no meaningful information and have virtually eliminated all stable, low and moderate flows from this reach. The result has been flows too low to paddle, or flashy, spiking flows on the order of 50,000 cfs. Intermediate paddlers, commercial paddlers, and general river-runners know little about this river bypass reach under any flow conditions.

Fish and boat passage project on the Gunnison River (Photo: McLaughlin Group)

Lower Chattahoochee whitewater park (Photo: McLaughlin Group)

It should be determined if there is adequate potential to build a whitewater park that offers a quality whitewater resource with adequate put-in, take-out, and return facilities that allow for use of the entire bypass reach.

(5) Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

The Bellows Falls project diverts the entire flow in the Connecticut River except during flood events when water enters the bypass reach. The bypass reach has no minimum flow, but there is leakage from the dam into the natural riverbed. The result is the virtual elimination of valuable and regionally needed summer paddling opportunities in the bypass reach. The Connecticut River can be a high-quality paddling resource, and since paddling is a flow-dependent activity, the project directly affects paddling on the Connecticut River. The project nexus is direct.

On- or off-site mitigation for loss of whitewater should also be evaluated in relation to the loss of Olcott Falls at and above the Wilder Dam, the rapids drowned beneath the Bellows Falls reservoir, and the loss of the rapids in the bypass reach.

Results of this study may produce evidence supporting mitigating license requirements for a whitewater park and scheduled releases in the bypass reach.

(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally

accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

We request a feasibility study for the establishment and construction of a whitewater park with possible fish passage using the design standards such as those developed by the McLaughlin Whitewater Design Group.

As experienced engineers, designers and hydrologists, they have worked extensively with municipalities, public utilities, the U.S. Army Corps of Engineers, and paddling groups throughout the United States. Their analysis should recommend whitewater structures to improve the run, and the work required to construct public access put-in, take-out return shuttle facilities for boaters, and possible additional fish passage.

The AMC will work with the Licensee, as we have in the past, to document the known information regarding the river. We will provide volunteer paddlers and technical support for the studies as appropriate. We hope to work collaboratively with the Licensee on this study.

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

The Appalachian Mountain Club is willing to work with the Licensee and its consultant on the whitewater park study to keep costs reasonable and the quality of information high.

Some preliminary work is needed. This is a bypass reach with limited access and relatively unknown hydrology. We recommend that the Licensee remove the small low-head weir at the base of the run and restore the natural shape of the river in consultation with whitewater engineers. The collaborative approach sought by the paddling community including in-kind contributions of time and expertise should help consultants complete these studies on behalf of the Licensee for a reasonable cost.

The Licensee PAD proposes no whitewater feasibility or whitewater park analysis. We currently do not know the relationship between specific low and moderate flows and the paddling experiences they might provide. A desktop analysis cannot generate this information. Without this analysis of the potential for a whitewater park, we cannot fully define the project impacts, nor propose and consider provision of releases that provide targeted recreational experiences.

4. Study of the Proper Presentation and Preservation of Important Historical Resources.

(1) Describe the goals and objectives of each study proposal and the information to be obtained.

Two types of important historical data should be studied in the relicensing of the Bellows Falls Dam.

First, a study should be done to determine a variety of options for educating the public about the Bellows Falls site. Indians inhabited the site for thousands of years, leaving behind some pictographs on both sides of the Bellows Falls bypass reach. Historic bridges and mills were present prior to the dam. The Licensee can and should contribute to the public benefit through educational outreach and displays concerning the history at the site. Informational signage and kiosks at project facilities can and should promote education about invasive species, water flows, the history of the area, who to call with problems, and what to do to get involved. Existing data should be archived and be publicly accessible. These educational improvements should be coordinated with recreational improvements. These questions should be addressed in this study concerning the “proper presentation” and preservation of history.

Sign leading to nowhere near Vilas Bridge, Bellows Falls, Vt.

The second sort of historical record here came from the construction of the Bellows Falls Dam in the late 1920s. The engineers who built this dam were highly skilled. They detailed each step of construction with carefully drawn documents and many photographs. These documents are now historical records and should be preserved.

We have an interest in the historical study of the river as it existed prior to the construction of the dams, including photographs of the natural riverbed. This will reveal what was lost during dam construction. TransCanada has easy access to around 24 scrapbook volumes of these records and photos. Each volume is numbered, but the numbers suggest there may be a total of 300 or more scrapbooks in existence. A study should determine what historical records remain and make suggestions for their safe storage, such as in a secure location or a library. The dam has changed hands repeatedly and is now owned by a Canadian corporation. These records should be preserved before they are lost in transition.

The dam was constructed in 1928 and is therefore old enough to be eligible for listing on the National Register of Historic Places. The canal associated with the dam is of itself highly significant, being the first such canal built in the United States.

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.

None of the three requesters is a public resource agency, although the AMC does keep a library of historical photographs and records at its headquarters on Joy Street in Boston. The tasks here are properly the concern of state historical preservation agencies. Indian tribes still in the area might have an interest, as well.

(3) If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.

Historical records are a valuable public resource. A traditional Native American fishing site on the Connecticut River is part of the collective heritage of Americans. For social, cultural and industrial historians, the records from construction of these dams will become a valued scholarly asset. They should not be lost because of ownership transitions, neglect, or because their value may not be recognized by a corporate employee.

Indian pictographs on river right, to the right of the
yellow markers, below Vilas Bridge.

(4) Describe existing information concerning the subject of the study proposal, and need for additional information.

Traditional Indian sites have a chance of preservation under current laws. That's not the point. The question is how can the operator of the Bellows Falls Dam benefit the public through the presentation of the historical issues at the site? That's where a study could suggest various opportunities.

The need for additional information here involves the documents in possession of TransCanada related to the original construction of the Bellows Falls Dam and to the original condition of the river.

(5) Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

Clearly the Licensee has in its possession scrapbooks, photographs, construction plans, and other historical records related to the construction of the dams, or at least some surviving remnant of such documents. The nexus there is direct. Preservation of such documents should be a license requirement and they should be publicly accessible.

Concerning the colonial and ancient history around Bellows Falls, FERC might require an educational component in the license requirements that could assist the public in understanding its history. This might be through direct Licensee action or through indirect support of appropriate institutions in Bellows Falls.

(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

In this case, tribal values and knowledge may be relevant in the case of Bellows Falls. The study methodology regarding interpreting Native American use of the area should be left to the tribes, and to professional historians, anthropologists, and archeologists.

Historians and librarians could recommend how to handle and preserve the scrapbook records and other historical information about building the dams.

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

Most of the work in locating the records owned by TransCanada would be internal, with advice and recommendations coming from professional historians after the scope and location of the documents is known.

5. Study of the Economic Health of Ownership and Creation of a Decommissioning or Trust Fund.

(1) Describe the goals and objectives of each study proposal and the information to be obtained.

We request a study on the creation of a decommissioning fund or trust fund to protect the public interest. New England’s rivers are littered with abandoned dams. Over the centuries, companies have failed, and weather events or human error have crippled dams that were then simply left behind. . Energy markets and ownerships have been changing quickly.

A “perfect storm” event, might breach one of the Connecticut River dams. These are elderly facilities, this one dating from 1928. The projected capacity at Bellows Falls Dam was exceeded in the 1936 flood.

Distant events, changing regulations, new energy sources, currency devaluations or unfortunate weather events could compromise the health of the project. If something happened, the public should be insured against the burden of decommissioning costs. A study should recommend the terms of a license requirement for a decommissioning fund.

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;

We are unaware of the resource agencies' jurisdiction over decommissioning funds.

(3) If the requester is a not resource agency, explain any relevant public interest considerations in regard to the proposed study.

The economic security of a federally licensed hydropower dam on the longest river in New England is clearly in the public interest. Many hydropower projects support robust recreation economies and they produce a public good by generating renewable forms of electricity.

But the historical record demonstrates—by the number of abandoned dams on New England's rivers—that the public should not accept the burden of industrial failure any longer. It has become common to create decommissioning funds at such federally licensed facilities as a way of insuring the public interest against having to pay for removal of a damaged facility or to take over from a failed corporation.

(4) Describe existing information concerning the subject of the study proposal, and the need for additional information.

We are unaware of any published information on the economic viability of the individual dams, which may need to be studied under a non-disclosure agreement, or of the performance of decommissioning funds or other trust funds for this purpose.

(5) Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

There is a direct connection between Project operations and the economic viability of each individual dam. Study results could lead to a license requirement setting up an escrowed decommissioning or trust fund to protect the public interest.

(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

The financial viability portion of the study would follow normal procedures in accounting and financial management. The rules of trusts or decommissioning funds are well known.

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

The requested study would be relatively inexpensive. Funding the trust would be another matter. We are unaware of alternative means of securing the public from risks that the corporations or the physical assets might fail during the course of the federal license.

Conclusion:

We respectively request the five studies described here, including an analysis of facilities for multiple-day river trips, a controlled-flow study, a study of a whitewater park, an investigation of historical and educational opportunities, and a decommissioning study. These studies will support dialog and analysis regarding the relicensing the Bellows Falls hydropower dam.

In addition, we offer our comments on the PADs to better inform this relicensing process. Thank you for considering these comments.

Respectfully submitted this 28th day of February, 2013.

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Bellows Falls bypass reach, looking upriver, October 2012.

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

TransCanada Hydro Northeast, Inc. Wilder Hydroelectric Project No. 1892-026

APPALACHIAN MOUNTAIN CLUB, VERMONT RIVER CONSERVANCY, AND THE FRIENDS OF THE CONNECTICUT RIVER PADDLERS' TRAIL COMMENTS AND STUDY REQUEST IN RESPONSE TO THE NOTICE OF INTENT TO FILE LICENSE APPLICATION, FILING OF PRE-APPLICATION DOCUMENT (PAD), COMMENCEMENT OF PRE-FILING PROCESS, AND SCOPING: REQUEST FOR COMMENTS ON THE PAD AND SCOPING DOCUMENT, AND INDENTIFICATION OF ISSUES AND ASSOCIATED STUDY REQUESTS REGARDING THE WILDER HYDROELECTRIC PROJECT, FERC PROJECT NO. 1892-026.

Since 1876, the Appalachian Mountain Club (AMC) has promoted the protection, enjoyment, and understanding of the mountains, forests, waters, and trails of the Appalachian region. The AMC is a steering committee member of the Hydropower Reform Coalition based in Washington, D. C. The AMC is the largest conservation and recreation organization in the Northeast with more than 90,000 members, many of whom live within three hours of the Connecticut River and would enjoy this section as a daylong or longer trip. The AMC's interests in hydropower relicensing are mainly in the areas of conservation and recreation.

The Vermont River Conservancy protects public access, wildlife habitat, clean waters, scenic natural beauty and ecological integrity by conserving undeveloped land along rivers, lakes and wetlands of Vermont. Since 1995, working in cooperation with state and federal agencies, municipalities and other conservation organizations, VRC has completed projects at over 45 popular local swimming holes, gorges and waterfalls, fishing and boating accesses, protecting paddlers' trails and meandering river corridors for all to enjoy.

The Friends of the Connecticut River Paddlers' Trail is dedicated to building and stewarding primitive campsites, access points, and portage trails along the Connecticut River. The organization manages over 30 campsites and 70 access points that reach from the Connecticut River's headwaters south to the Massachusetts border. Efforts are underway to expand the trail into Massachusetts and Connecticut. The group includes representatives from conservation organizations, state and federal agencies, hydroelectric companies, and town conservation commissions that recognize the region's rich ecology and productive working landscape and seek to facilitate recreational use compatible with the Refuge's natural, social, and historic character.

Currently five hydropower projects on the Connecticut River are up for new federal licenses, with Wilder Dam being the farthest north. These five facilities influence about 168 miles of the longest river in New England, including creating 91 miles of reservoir that have fragmented the river and converted whitewater rapids into impoundments. The impacts stretch from the upper reaches of the 45-mile long Wilder Project reservoir in New Hampshire and Vermont down to about Northampton, or possibly the Holyoke Dam reservoir, in Massachusetts. The watershed surrounding these projects encompasses a significant portion of the 7.2 million acres in the Connecticut River and Watershed National Blueway. This section of the Connecticut River has drowned three significant rapids at Olcott Falls under the reservoir and has another rapid, Sumner Falls, seven miles downstream. The main stem is of sufficient size for canoeing, kayaking and rowing for multiple-day trips, and flows through beautiful Appalachian countryside.

Rather than repeating some requests here, the AMC co-signed onto American Whitewater and New England FLOW's study requests for whitewater recreation and contingent valuation economic studies and hereby references them without repeating them in detail for brevity's sake. This includes controlled-flow studies as have been done on dozens of FERC projects, specifically at Sumner Falls, which is a popular kayak play spot used by paddlers from a wide region. The recreational values there would be improved by scheduled releases. On- or off-site mitigation for loss of whitewater should also be evaluated in relation to the loss of Olcott Falls at and above the Wilder Dam.

In the following study requests, we additionally address impacts of and study needs for the Wilder Project, including issues of multiple-day river trips, historical and cultural resources, and the financial health of the operator and decommissioning funds.

All studies requested here should contain projections for use by the public during the 30-year life of the proposed license, and the adequacy of all facilities and mitigation for that time period, as well as how existing impediments discourage public use.

In addition to recreation and aesthetics, we recognize that flow-related decisions also affect economic factors related to power generation and other environmental variables. We look forward to exploring how all flow values relate to one another through participation in this relicensing process.

Issue #1: Impacts of Wilder Dam on Multiple-Day Self-Propelled Trips on the Connecticut River.

In the scoping area of recreation, we have an interest in the creation of improved opportunities for multiple-day canoe and kayak trips on the Connecticut River, along with facilities that would also accommodate rowing shells. When compared to other regions of the country, New England generally does not have a lot of opportunities for multiple-day canoe trips with the exception of several rivers in far northern Maine, such as the St. John and Allagash, which are many hours from population centers. The Connecticut River runs from northern New Hampshire to Long Island Sound. It passes through several major population centers and is easily accessible from all the cities in New England as well as the greater New York City area with populations in the millions.

The most serious obstacles to multiple-day trips on the Connecticut River are the hydropower dams themselves. The Wilder Dam owned by TransCanada blocks the river to downstream navigation. Access near the population centers of Hanover, Norwich, and West Lebanon are nonexistent or inadequately developed and campsites are inadequate.

The primitive campsites in the Upper Valley are among the most popular destinations in the river. Use often exceeds their capacity. Furthermore, interest is growing. Campers often resort to camping illegally on islands, degrading sensitive ecological habitat. There is a need to establish additional primitive, well-managed campsites to meet this demand.

The portage trail at Wilder Dam is long, steep, and challenging to anyone carrying a canoe. In addition, the route does not accommodate travelers using portage carts to wheel their canoes. Once paddlers reach the bottom of a steep stone stairway, they must walk to the river through something resembling a sandbox mixed with football-sized stones. A shorter and safer path could be located on the other side of the river if a study recommends it. At the Sumner Falls site, there is a portage trail for river travelers who do not want to run the rapids. It could be improved and its land base should be secured for long-term protection. Additional land-based amenities could be added such as potable water, toilets, campsites, and way-finding signage that would be used by play boaters at Sumner, by paddlers engaged in multiple-day trips on the river, and by visitors. Wayfinding signage is needed for visitors seeking to launch their boats in this region. In addition, in the vicinity south of Summer Falls is a river terrace that may be suitable for the establishment of a primitive campsite.

Wilder Dam portage, steep stone stairway.

Possible portage route on other side of the river.

In preliminary application documents, the Licensee cites the goals of the New Hampshire SCORP, which identified the need for a variety of recreational opportunities. The Vermont SCORP (2005-2009) reveals the need for access to all types of outdoor recreation. Multiple-day canoe, kayak or rowing trips certainly meet the needs identified in the SCORP documents, but such trips are severely limited by the operations of the hydropower dams.

Facilities such as portages, campsites, and boat ramps do exist, as detailed in the PAD. But for multiple-day trips, or for paddlers or rowers seeking to navigate the length of the Connecticut River, the dams discourage such travel. Fisheries biologists have suggested that migrating fish tire after the second fish ladder. Canoeists faced with the cumulative obstacles presented by the hydropower dams become similarly discouraged and abandon their efforts to migrate downriver.

In the PAD, the Licensee proposes no enhancements to mitigate the project effects on multiple-day canoe and kayak recreational use.

Issue #2: Controlled-flow Study at Sumner Falls.

Sumner Falls, also known as Hartland Rapid, can be found seven miles below Wilder Dam. It is a series of ledges sprawled across a wide section of the Connecticut River that creates a whitewater play spot of approximately one-quarter mile. There are many surfing waves and the area is an excellent place for training beginning boaters and for play boaters. A large eddy on river right allows boaters to easily paddle back upriver and repeat the run. At generation and higher flow levels this site provides excellent surfing and currents for squirt boating. At moderate flows the run provides opportunities to complete a wide array of acrobatic tricks called freestyle paddling.

Wilder Dam drowned all three stretches of a significant 2.5-mile whitewater run known as Olcott Falls. Nothing will bring that back now. Scheduled releases at Sumner Falls would be scant compensation for that loss.

Sumner Falls at low water, October 2012.

Issue #3: Rescuing Important Historical, Educational, and Cultural Records.

In the scoping area of historical and cultural resources, relicensing these projects offers perhaps a last chance to rescue important historical records. TransCanada holds significant historical records related to the design and construction of the hydropower facilities on the Connecticut River. Engineers who constructed the dams made detailed drawings, inventories, and photographic records. We have an interest in the historical records of the river as it existed prior to the construction of the dams, including photographs of the natural riverbed at and above Wilder Station in the reach known as Olcott Falls. This will reveal what was lost during dam construction.

TransCanada has easy access to around 24 scrapbook volumes of these records and photos for its Connecticut River dams. Each volume is numbered, and the numbers suggest there may be a total of 300 or more scrapbooks in existence. A study should determine what historical records remain and make suggestions for their safe storage and for public access. This dam has gone through multiple ownership changes in recent years and is currently owned by a Canadian corporation. These records should be preserved before they are lost in transition.

The AMC has an active volunteer and staff educational program, and we have an interest in the educational benefits that should be provided to the public by the hydropower operators on the Connecticut River. Informational signage and kiosks at project facilities can promote education about invasive species, water flows, the history of the area, who to call with problems, and what to do to get involved. Such educational improvements should be coordinated with recreational improvements.

This relicensing offers perhaps a last chance to rescue important historical records held by the Licensee related to the design and construction of the hydropower facilities as well as to historical, pre-project conditions A study should determine what historical records remain, and make suggestions for their safe storage, for making them publicly accessible, and for improvements at the project to highlight the historical significance of the facilities to the public.

Olcott Rapids before the Wilder Dam was constructed.

Issue#4: Economic Health and Decommissioning.

Energy markets have changed dramatically in the past decade. The ownership turnover of energy facilities has been dramatic. Climate change may cause more frequent catastrophic and extraordinary events in coming years in the Connecticut River Valley, such as Tropical Storm/Hurricane Irene in 2011, which washed out some portion of almost every state highway in Vermont except the Interstates. With the possibilities of millennial weather events occurring with much greater frequency and the ongoing dramatic changes in the competiveness in current energy generating sources, we believe that a study should assess the need for escrowed decommissioning funds or trust funds for all hydroelectric facilities currently up for new licenses. Many outdated and derelict dam removals today are coming at the expense of public dollars.

We recommend a study to determine the appropriate decommissioning costs at the end of this project’s lifetime and how such costs should be funded in escrow in advance. In an age of international ownership, deregulation, changing ownership, and climate change, the financial health of ownership can be brought into jeopardy by distant events or by weather-related catastrophic failure of a dam. The public should not be burdened with decommissioning costs.

Wilder Station, October 2012

Study Requests

We hereby request the following studies per 18 CFR 5.9(b).

1. Study of Project Facilities to Support Multiple-day Self-Powered Boating Trips on the Connecticut River.

(1) Describe the goals and objectives of each study proposal and the information to be obtained.

We recommend a study of the quantity, quality, and adequacy of land-based recreational facilities operated by the Wilder Station Licensee that are associated with boating on the Connecticut River. This study should examine put-in and take-out facilities especially for canoes, kayaks, rowing shells and other self-powered watercraft; portage routes at Wilder Station and Sumner Rapids; campsites; parking and road access; seasons of operation of the facilities to match with actual river use; maintenance; water supplies and other amenities at campsites; and trash and sanitary facilities. The study should include a projection of usage during the proposed 30-year life of the license, and opportunities for the Licensee to buy land from willing sellers in order to increase and safeguard recreational benefits for the project's tenure.

The study should examine the facilities that are necessary specifically for canoe, kayak and rowing shell access to the river. Information from the New Hampshire and Vermont SCORP studies and from other river recreational groups suggests that interest in quiet water paddling is rising along with the sales of sea kayaks, rowing shells and canoes. Most of the existing facilities were designed for day use by motorboats. Motorboat launch ramps are not well suited to canoeists, especially those using wood-and-canvas or fiberglass canoes (e.g., sand works better than concrete.)

Paddlers who have attempted multiple-day trips on the Connecticut River report that portages and camping can be difficult. Campsites are few and far between and the quality varies widely. Islands are often posted as off-limits. Competition for campsites is common, and the study might look at ways to minimize such conflicts. The Connecticut River Paddlers' Trail organization states the ideal frequency of canoe campsites is one in every five river miles, accompanied by canoe and kayak access in every town. The Licensee could use that guidance.

Trails on both land and water should be studied. The Connecticut River Paddlers' Trail and the Connecticut River Birding Trail are within project boundaries. Their interests should be part of a study framework that takes a watershed viewpoint, especially as it involves trail networks and associated facilities.

The ownership of project lands at Wilder Station should be studied for recreational and conservation improvements. Some project lands could be added to existing park facilities, or placed under permanent conservation restrictions, in order to improve conservation and recreation. The public has an interest in trails in the vicinity of project lands. The study should evaluate the adequacy and maintenance of existing trail systems for the next 30 years, and determine opportunities for additional hiking trails on project lands, and for linking those trails to existing trails.

In association with this study, the creation of the Connecticut River and Watershed National Blueway should be taken into account, along with ways that the existing hydropower facilities can contribute to that effort. The study should take into consideration impacts on the entire watershed.

As part of the "adequacy" study, for example, a survey should seek to determine why people do NOT use this great public resource. The cumulative discouragement of recreation on the Connecticut River may displace use to other areas of the watershed. As with upstream migration of fish and downstream migration of canoeists, the survey might identify several discouraging aspects of project operations that could be corrected during relicensing.

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;

None of the three requesters is a resource agency. However, several state and federal agencies have an interest in recreation and conservation on the Connecticut River.

The Connecticut River Joint Commissions, created by the legislatures of Vermont and New Hampshire in the late 1980s, is directed to cooperate with each other to preserve and protect the resources of the Connecticut River Valley, and to guide its growth and development. In 2009, CRJC's five local river subcommittees completed a major update of their recreation plan for the river region. The study is aligned with several of the headwaters subgroup's top ten priorities, which aim to:

- Encourage protection of open space for public recreation and scenic views. *Towns should take advantage of opportunities to conserve riverfront land for public access, trails, birding, or other recreation. Land conservation organizations should help protect scenic views and open space, especially along the river, providing public recreation access for birding, car-top boats or trails.*
- Provide more primitive camping opportunities. *Parks and recreation agencies should help recreation groups and local volunteers to establish and coordinate a new water trail of dispersed primitive canoe campsites in the region to help prevent trespassing and disperse camping impacts.*

The states of Vermont and New Hampshire manage recreational sites in the vicinity of the TransCanada facilities. There is a clear interest in the public's ability to traverse the Connecticut River in boats. The Connecticut River Atlantic Salmon Commission (CRASC), the Vermont Department of Fish & Wildlife (VT-F&W), the U. S. Fish & Wildlife Service (USF&W), and the National Marine Fisheries Service (NMFS) have a clear interest in the passage of anadromous and other migratory fish including shad, blue-back herring, eels and other species through fish ladders at the Wilder Dam. Although the federal Atlantic Salmon Restoration Program has been recently curtailed, some of the above agencies continue to study and promote the effective upstream and downstream passage of many endangered or threatened species.

Beyond the fisheries agencies, several federal agencies have an interest in recreation and conservation on the Connecticut River. On May 24, 2012, Secretary of the Interior Ken Salazar designated the Connecticut River and Watershed as the nation's first National Blueway. A Memorandum of Understanding signed in August 2012 by the departments of Interior, Agriculture, and the Army has as one objective "providing opportunities for scientific research, environmental education and outdoor recreation and access within the National Blueway to the extent compatible with agency missions." The National Blueway concept takes a watershed viewpoint and addresses the river from its source to the sea. The National Blueways System has as its goal "to advance a whole river and watershed-wide approach to conservation, outdoor recreation, education, and sustainable economic opportunities in the watersheds in which we live, work, and play." The National Blueway designation includes all the tributaries in the watershed and involves several federal and state agencies, including the U.S. Army Corps of Engineers, the Silvio Conte Refuge, U.S. Fish and Wildlife Service, the National Park Service, and the States of Connecticut, Vermont, New Hampshire, and the Commonwealth of Massachusetts, which have prioritized conservation, recreation, and restoration in the 7.2 million-acre Connecticut River Watershed.

(3) If the requester is a not resource agency, explain any relevant public interest considerations in regard to the proposed study.

As explained above, the hydropower dams on the Connecticut River create obstacles to public navigation and recreation on the river. Conducting the necessary studies and implementing the measures needed to ensure that the public has access to quality outdoor recreational resources are in the public interest. It is widely accepted that outdoor recreation has significant benefits to participants including health, well being, and quality-of-life. Outdoor recreation also has proven economic benefits for communities located near recreational resources.

Improvement in opportunities for multiple-day canoe, kayak and rowing trips on the Connecticut River has the potential to offer the region significant economic benefits.

Project operations have created serious aesthetic issues along the route of the Connecticut River. The dams have substituted their industrial appearance for the naturally scenic rapids and falls that graced the Connecticut River at Wilder in Olcott Falls. The public has an interest in the scenic values of this major public resource.

(4) Describe existing information concerning the subject of the study proposal, and the need for additional information.

There is an inconsistent body of knowledge regarding multiple-day trips on the Connecticut River. The PAD produced by the Licensee lists many access and camping facilities that are not owned or operated by the Licensee, including commercial operations that may have a temporary lifespan. There is a lack of consistency about those facilities in terms of their seasons of use and their amenities for public recreational use and their long-term protection.

Several publications are widely used by paddlers and recreationalists. The primary source of information is *The Connecticut River Boating Guide: Source to Sea* (3rd ed.) published by the Connecticut River Watershed Council (2007). The Connecticut River Birding Trail organization located in White River Junction, Vt., has published maps detailing the upper valley section, the northern section, and the southern section of the river.

Images of America: Hartford by Frank J. Barrett Jr. has a chapter on “Olcott, Wilder, and the Connecticut River” that contains photos of Olcott Falls before the dam.

The Connecticut River Paddlers’ Trail in 2013 published a map of the river. Their website (www.connecticutriverpaddlerstrail.org) has a comprehensive listing of access points and campsites in Vermont and New Hampshire.

The Connecticut River Joint Commissions updated the Recreation Chapter of the Connecticut River Corridor Management Plan recently — there are six volumes, all posted online at: http://www.crjc.org/river-plan/recreation-management-plan/ The Upper Valley, Mount Ascutney and Wantastiquet plans will be most relevant as they each contain a section on boating for that section of the river.

(5) Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

The Wilder Dam prevents navigation downstream on the main stem of the Connecticut River. Project owners have a responsibility to the public to provide adequate portage trails and facilities that promote public recreation on the river, including access points and campgrounds with necessary amenities. This study will be the defining mechanism for identifying additional sites that can best be adapted for increasing public access and multiple-day paddling trips on the Connecticut River. License requirements may include having the Licensee purchase additional property to provide adequate camping, trail sites, portages or other facilities to assist the public.

The study may also identify indirect effects if the hydropower facilities and their projects have discouraged public use of the Connecticut River or displaced recreation to other parts of the watershed.

Cumulative effects need to be examined because it appears that the number of dams on the river discourages multiple-day trips and has fragmented the recreational experience. This study may result in license requirements or other mitigation for the Licensee regarding multiple-day trips on the Connecticut River.

(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

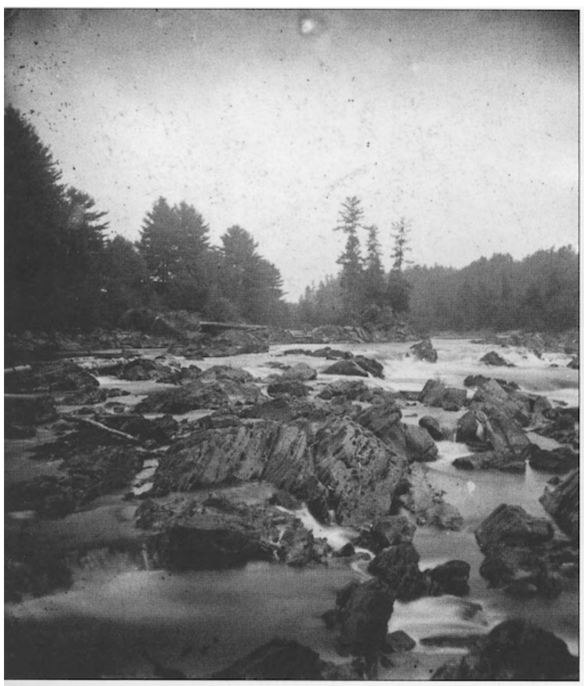
Studies of the adequacy of public resources are fairly standard in the planning field. Methodologies can be selected from among the recognized and accepted standards of the resource and public planning fields. Surveys of people who do NOT use the river or are displaced elsewhere in the watershed can employ randomized samples from several databases. Sufficient information is available from the guidebooks and maps of the river that identify access points and campsites, as well as information contained in the PAD. The sites evaluated should be operated or funded by the Licensee, not by others. Once a consultant is selected and approved, the information should be gathered and analyzed in a timely manner. The study would probably need a summer field season to locate river users for an adequate sample. A consultant with experience in similar projects should be selected, in part to create relevant comparisons to other hydropower projects around the country.

The AMC has some staff expertise in this area because it operates facilities in the White Mountains in New Hampshire, near the Appalachian Trail in Maine, and elsewhere in its chapter locations. We will work with the Licensee to document the known information regarding the river. We will provide volunteers and technical support for the studies when possible as appropriate. We hope to work collaboratively with the Licensee on this study.

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

There are several sites along the Connecticut River in the Wilder area, private and public, that are used as access points or have camping facilities. However, there are vast differences in the ability or capacity of these sites to handle paddling groups with varying sizes or sanitation needs. Because there is no comprehensive guide or text that provides updated information, field inspection of existing sites should take place. Any needed reconstruction or rehabilitation of existing facilities should be identified. This analysis can be completed during any spring, summer, or fall field season.

Such field research needs to be matched with projections of use in the future and with standard requirements for access sites, campsites, portages, sanitation facilities and other amenities. We know of no other method to acquire this information for evaluation.



Olcott Falls middle drop, 1882.

2. Controlled Whitewater Flow Study for the Sumner Falls Reach.

(1) Describe the goals and objectives of each study proposal and the information to be obtained.

As stated in the American Whitewater and New England FLOW study requests, the goal of a whitewater controlled-flow study is to assess the presence, quality, access needs, flow information needs, and preferred flow ranges for river-based boating resources in a stepwise manner. The information to be obtained can be generally characterized as quantitative and qualitative descriptions of:

- The range of optimal and acceptable flows for whitewater paddling in a river setting;
- The frequency, timing, duration and predictability of optimal and acceptable paddling flows under current conditions, and how proposed alternative operations could be used;
- The access needs of whitewater boating use and the current and potential river access options for kayakers and other paddlers, as well as portage opportunities;
- The flow information needs of whitewater boating and the current and potential flow information distribution system;
- The location, challenge, and other recreational attributes associated with Sumner Falls Rapid and other river features that may be available.

Thus, the information to be obtained for the whitewater controlled-flow study is a combination of user-generated flow preferences and other information on current and proposed operation (e.g. discharges), geographic information and basic recreational information.

In simpler terms, Wilder Station would release prescribed flows of water for this test, perhaps over two days. When each release reaches Sumner Rapids, a selected group of paddlers would run the rapid and then answer written questions about their experiences at that flow level. Wilder Station would release three or four or possibly several different flows, measured in cubic feet per second, and the paddlers' experiences would be analyzed to determine the flows that work best at the rapid.

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.

None of the three requesters is a resource agency.

The Licensee owns and operates several river access areas on the Connecticut River within project boundaries, and both the states of Vermont and New Hampshire manage additional sites in the vicinity of the Project. There is a clear interest in the public's ability to traverse the Connecticut River in boats and to develop recreational uses. In addition to this interest, the Connecticut River and Watershed has been designated as

America's first National Blueway, a designation that engages several federal and state agencies in the Connecticut River and Watershed.

On May 24, 2012, Secretary of the Interior Ken Salazar designated the Connecticut River and Watershed as the nation's first National Blueway. A Memorandum of Understanding signed in August by the departments of Interior, Agriculture, and the Army has as one objective "providing opportunities for scientific research, environmental education and outdoor recreation and access within the National Blueway to the extent compatible with agency missions." The National Blueway concept takes a watershed viewpoint and addresses the river from its source to the sea. The National Blueways System has as its goal "to advance a whole river and watershed-wide approach to conservation, outdoor recreation, education, and sustainable economic opportunities in the watersheds in which we live, work, and play." The National Blueway designation includes all the tributaries in the watershed and involves several federal and state agencies, including the U.S. Army Corps of Engineers, the Silvio Conte Refuge, U.S. Fish and Wildlife Service, the National Park Service, and the States of Connecticut, Vermont, New Hampshire, and the Commonwealth of Massachusetts, which have prioritized conservation, recreation, and restoration in the 7.2 million-acre Connecticut River Watershed.

(3) If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.

The Wilder Dam offers the public an opportunity to enjoy a quality whitewater boating resource at Sumner Falls. Conducting the necessary studies and implementing the measures needed to ensure the public has access to quality outdoor recreational resources are in the public interest. It is widely accepted that outdoor recreation has significant benefits to participants including health, well being, and quality-of-life. Outdoor recreation also has proven economic benefits for communities located near recreational resources.

Scheduled recreational opportunities in the Connecticut River and its tributaries have the potential to offer the region significant economic benefits. FERC has concluded that *"to fully evaluate the project's effect on whitewater recreation opportunities and to balance potential enhancement opportunities with their cost, a controlled-flow whitewater boating study is relevant to Commission's public interest determination."* This is equally true regarding the Sumner Falls reach on the Connecticut River.

(4) Describe existing information concerning the subject of the study proposal, and need for additional information.

While many controlled-flow studies as described above have been conducted on New England's rivers (Deerfield in Massachusetts, Kennebec & Rapid in Maine) that have a long and illustrious history of whitewater paddling use, flows on this section of the Connecticut River have been fractured and are undependable. The potential of developing a quality river reach at Sumner Falls as a recreational facility and destination should not be ignored.

Current and historic project operations, however, provide no consistent releases, easily accessible flow information by the public or meaningful information for this reach. The result has been flows too low to paddle, or flashy, spiking high flows that flatten out the rapids. It should be determined what flows are best suited for maximum recreational use.

Doug Whittaker, Bo Shelby, and John Gangemi describe the techniques for controlled-flow studies in *Flows and Recreation: A guide to studies for river professionals* (2005), p. 26-29, available from the National Park Service website at:
http://www.nps.gov/hydro/flowrec.pdf

(5) Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

The Wilder Dam controls the entire flow in the Connecticut River with the exception of releasing the required minimum flow of 675 cfs, when generating, or during floods.

The result is chaotic and unpredictable timing for paddlers wishing to paddle at Sumner Falls, and the elimination of valuable and regionally needed summer paddling opportunities. The Connecticut River can be a high quality paddling resource, and since paddling is a flow dependent activity, the project directly affects paddling on the Connecticut River. The project nexus is direct. The results of a controlled-flow study would help determine the need for license requirements for whitewater releases.

(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

We request a controlled-flow study of the Sumner Falls reach of the Connecticut River. The study should follow the standard methodology as described in Whittaker et al., cited above. This methodology is designed to gather information to assess the presence, quality, and preferred flow ranges for river-based boating resources in a step-wise manner. The process steps are generally 1) desktop analyses, 2) on-land feasibility assessment, 3) on-water single flow assessment, 4) on-water multiple flow assessment.

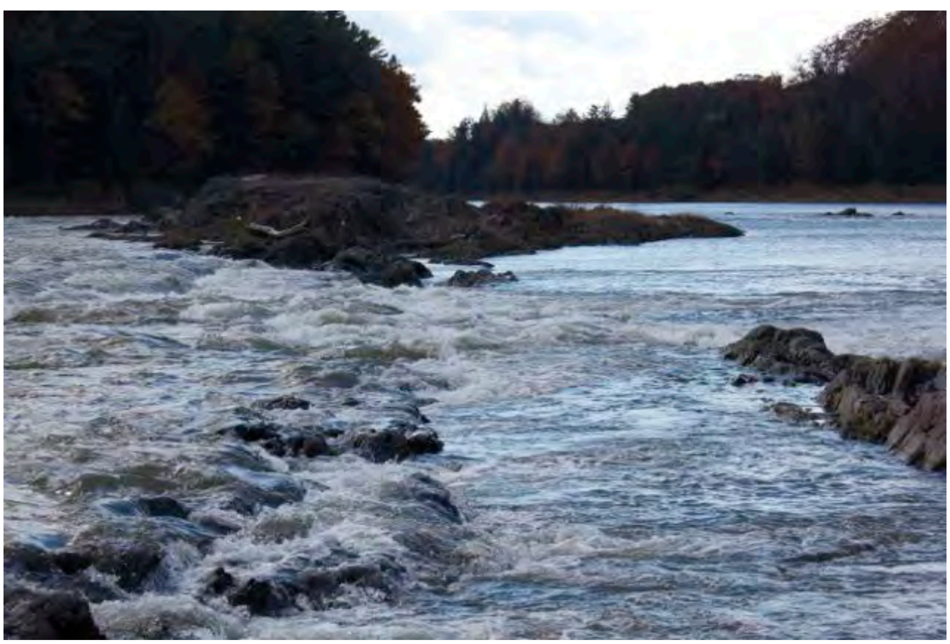
The AMC and other NGOs with whitewater experience are willing to work with the Licensee to document the known information regarding the river. We can provide volunteer paddlers and technical support for the studies as appropriate. We hope to work collaboratively with the Licensee on this study. The whitewater boating study methodology we have requested has been used on dozens of other FERC regulated reaches, including other rivers where the studies were done in conjunction with New England Power whose projects are now owned by TransCanada.

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

Representatives of the AMC are willing to work with the Licensee on the whitewater paddling controlled-flow study at Sumner Falls to keep costs reasonable and the quality of information high.. The organized flow study should be done, during which several flows are paddled by boaters with still image and video documentation, followed by surveys of the boaters, a guided conversation among the boaters, and subsequently a written report.

Given that this is a main stem reach with decent access and relatively known hydrology, and given the collaborative approach sought by the paddling community, including in-kind contributions of time and expertise, consultants should be able to complete this study on behalf of the Licensee for a very reasonable cost.

The Licensee PAD proposes no whitewater feasibility analysis. This no-action step will reveal nothing about the project's impacts on whitewater recreation at Sumner Falls or opportunities for protection, mitigation, or enhancement measures. We currently do not know the relationship between specific low and moderate flows and the paddling experiences they provide. A desktop analysis cannot generate this information. Without this information gained from paddling this reach, we cannot fully define the project impacts, nor propose and consider provision of releases that provide targeted recreational experiences.



Sumner Falls Rapids at low flow, October 2012.

3. Study of the Proper Presentation and Preservation of Important Historical Resources.

(1) Describe the goals and objectives of each study proposal and the information to be obtained.

Important historical records were created during construction of the Wilder Dam. The engineers who built the dam were highly skilled, judging from the longevity of their structures. They detailed each project with carefully drawn documents and many photographs of the land and the construction. These documents are now historical records and should be preserved.

We have an interest in the historical study of the river as it existed prior to the construction of the dams, including photographs of the natural riverbed. This will reveal what was lost during dam construction, including the drowning of Olcott Falls. TransCanada has easy access to around 24 scrapbook volumes of these records and photos for their Connecticut River facilities. Each volume is numbered, but the numbers suggest there may be a total of 300 or more scrapbooks in existence. A study should determine what historical records remain and make suggestions for their safe storage, such as in a secure location or a library. A Canadian corporation now owns the facility. These records should be preserved before they are lost in transition.

We also have an interest in the educational opportunities for the public that should be provided by the project operators on the Connecticut River. Informational signage and kiosks at project facilities can and should promote education about invasive species, water flows, the history of the area, who to call with problems, and what to do to get involved? Existing data should be archived and be publicly accessible. These educational improvements should be coordinated with recreational improvements. These questions should be addressed in this study concerning the "proper presentation" and preservation of history.

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.

None of the three requesters is a resource agency, although the AMC does keep a library of historical photographs and records at its headquarters on Joy Street in Boston. The tasks here are properly the concern of state historical preservation agencies.

(3) If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.

Historical records are a valuable public resource. For social, cultural and industrial historians, the records from construction of this dam will become valued scholarly assets. They should not be lost because of ownership transitions, neglect, or because their value may not be recognized by a corporate employee.

(4) Describe existing information concerning the subject of the study proposal, and need for additional information.

We are unaware of any publications that have used these company records. The need for additional information here involves the documents in possession of the Licensee related to the original construction of the dams and to the original condition of the river.

(5) Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

Clearly the Licensee has in its possession scrapbooks, photographs, construction plans, and other historical records related to the construction of the dam, or at least some surviving remnant of such documents. The nexus there is direct. Preservation of such documents should be a license requirement and they should be publicly accessible.

(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

Historians or librarians could recommend how to handle and preserve the scrapbook records and other historical information about building the dam.

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

Most of the work in locating the records owned by the Licensee would be internal, with advice and recommendations coming from professional historians after the scope and location of the documents is known. Study of educational opportunities would benefit from consultations with local outdoor educators and schools.

4. Study of the Economic Health of Ownership and Creation of a Decommissioning or Trust Fund.

(1) Describe the goals and objectives of each study proposal and the information to be obtained.

We request a study on the creation of a decommissioning fund or trust fund to protect the public interest. New England's rivers are littered with abandoned dams. Over the centuries, companies have failed, and weather events or human error have crippled dams that were then simply left behind. Energy markets and ownerships have been changing quickly.

A "perfect storm" event, might breach a dam such as Wilder. Most of the Connecticut River dams are elderly facilities; Wilder is one of the youngest but dates from 1950. The projected capacity at Bellows Falls Dam was exceeded in 1936.

Distant events, changing regulations, new energy sources, currency devaluations or unfortunate weather events could compromise the health of the current projecte. If something happened, the public should be insured against the burden of decommissioning costs. A study should recommend the terms of a license requirement for a decommissioning fund.

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;

We are unaware of the resource agencies' jurisdiction over decommissioning funds.

(3) If the requester is a not resource agency, explain any relevant public interest considerations in regard to the proposed study.

The economic security of a federally licensed hydropower dam on the longest river in New England is clearly in the public interest. Many hydropower projects support robust recreation economies and they produce a public good by generating renewable forms of electricity.

But the historical record demonstrates—by the number of abandoned dams on New England's rivers—that the public should not accept the burden of industrial failure any longer. It has become common to create decommissioning funds at such federally licensed facilities as a way of insuring the public interest against having to pay for removal of a damaged facility or to take over from a failed corporation.

(4) Describe existing information concerning the subject of the study proposal, and the need for additional information.

We are unaware of any published information on the economic viability of the Wilder Dam, which may need to be studied under a non-disclosure agreement, or of the performance of decommissioning funds or other trust funds for this purpose.

(5) Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

There is a direct connection between Project operations and the economic viability of each individual dam. Study results could lead to a license requirement setting up an escrowed decommissioning or trust fund to protect the public interest.

(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

The financial viability portion of the study would follow normal procedures in accounting and financial management. The rules of trusts or decommissioning funds are well known.

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

The requested study would be relatively inexpensive. Funding the trust would be another matter. We are unaware of alternative means of securing the public from risks that the corporations or the physical assets might fail during the course of the federal license.

Conclusion:

We respectively request the recreational, historical, and economic studies that will support dialog and analysis regarding the impact of the Wilder hydropower dam on the Connecticut River and on Sumner Rapid.

In addition, in these comments we offer our comments on the PADs, to better inform this relicensing process. Thank you for considering these comments.

Respectfully submitted this 28th day of February, 2013.

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UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

TransCanada Hydro Northeast, Inc. Vernon Hydroelectric Project No. 1904-073

APPALACHIAN MOUNTAIN CLUB, VERMONT RIVER CONSERVANCY, AND FRIENDS OF THE CONNECTICUT RIVER PADDLERS' TRAIL'S COMMENTS AND STUDY REQUESTS
IN RESPONSE TO THE
NOTICE OF INTENT TO FILE LICENSE APPLICATION, FILING OF PRE-APPLICATION DOCUMENT (PAD), COMMENCEMENT OF PRE-FILING PROCESS, AND SCOPING: REQUEST FOR COMMENTS ON THE PAD AND SCOPING DOCUMENT, AND INDENTIFICATION OF ISSUES AND ASSOCIATED STUDY REQUESTS REGARDING THE VERNON HYDROELECTRIC PROJECT, FERC PROJECT NO. 1904-073, OWNED BY TRANSCANADA HYDRO NORTHEAST, INC.

Since 1876, the Appalachian Mountain Club (AMC) has promoted the protection, enjoyment, and understanding of the mountains, forests, waters, and trails of the Appalachian region. The AMC is a steering committee member of the Hydropower Reform Coalition based in Washington, D. C. The AMC is the largest conservation and recreation organization in the Northeast with more than 90,000 members, many of whom live within three hours of the Connecticut River and would enjoy this section as a daylong or longer trip. The AMC's interests in hydropower relicensing are mainly in the areas of conservation and recreation.

The Vermont River Conservancy protects public access, wildlife habitat, clean waters, scenic natural beauty and ecological integrity by conserving undeveloped land along rivers, lakes and wetlands of Vermont. Since 1995, working in cooperation with state and federal agencies, municipalities and other conservation organizations, VRC has completed projects at over 45 popular local swimming holes, gorges and waterfalls, fishing and boating accesses, protecting paddlers' trails and meandering river corridors for all to enjoy.

The Friends of the Connecticut River Paddlers' Trail is dedicated to building and stewarding primitive campsites, access points, and portage trails along the Connecticut River. The organization manages over 30 campsites and 70 access points that reach from the Connecticut River's headwaters south to the Massachusetts border. Efforts are underway to expand the trail into Massachusetts and Connecticut. The group includes representatives from conservation organizations, state and federal agencies, hydroelectric companies, and town conservation commissions that recognize the region's rich ecology and productive working landscape and seek to facilitate recreational use compatible with the Refuge's natural, social, and historic character.

Currently five hydropower projects on the Connecticut River are up for new federal licenses, including Vernon Dam. These five facilities influence about 168 miles of the longest river in New England, including creating 91 miles of reservoir that have fragmented the river and converted whitewater rapids into impoundments. The impacts stretch from the upper reaches of the 45-mile long Wilder Project reservoir in New Hampshire and Vermont down to about Northampton, or possibly the Holyoke Dam reservoir, in Massachusetts. The watershed surrounding these projects encompasses a significant portion of the 7.2 million acres in the Connecticut River and Watershed National Blueway. The main stem of the river at the Vernon Project is of sufficient size for canoeing, kayaking and rowing for multiple-day trips, and flows through beautiful Appalachian countryside.

Rather than repeating some requests here, the AMC co-signed onto American Whitewater and New England FLOW’s study requests for whitewater recreation and contingent valuation economic studies and hereby reference them without repeating them in detail for brevity’s sake.

In the following study requests, we address impacts of and study needs for the Vernon Project, including issues of multiple-day canoe trips, historical and cultural resources, and the financial health of the operator and decommissioning funds.

All studies requested here should contain projections for use by the public during the 30-year life of the proposed license, and the adequacy of all facilities and mitigation for that time period, as well as how existing impediments discourage public use currently.

Issue #1: Impacts of the Vernon Dam on Multiple-Day Self-Propelled Trips on the Connecticut River.

The Vernon Dam owned by TransCanada blocks the river to downstream navigation.

In the scoping area of recreation, we have an interest in the creation of improved opportunities for multiple-day canoe and kayak trips on the Connecticut River, along with facilities that would also accommodate rowing shells. When compared to other regions of the country, New England generally does not have a lot of opportunities for multiple-day canoe trips with the exception of several rivers in far northern Maine, such as the St. John and Allagash, which are many hours from population centers. The Connecticut River runs from northern New Hampshire to Long Island Sound. It passes through several major population centers and is easily accessible from all the cities in New England as well as the greater New York City area with populations in the millions.

In preliminary application documents, the Licensee cites one of the goals of the New Hampshire SCORP for a variety of recreational opportunities. The Vermont SCORP (2005-2009) reveals the need for access to all types of outdoor recreation. Multiple-day canoe, kayak or rowing trips certainly meet the needs in the SCORP documents, but such trips are severely limited by the operations of the hydropower dams.

The most serious obstacles to multiple-day trips on the Connecticut River are the hydropower dams themselves. Access points and campsites are inadequate. The existing portage routes around the dams are inadequate, too long, and dangerous. The portage trail at Vernon Dam is among the best, yet through-paddlers frequently complain about it.

Facilities such as portages, campsites, and boat launches exist, as detailed in the PAD. But for multiple-day trips, or for paddlers or rowers seeking to navigate the length of the Connecticut River, the dams discourage such travel. Fisheries biologists have suggested that migrating fish tire after the second fish ladder. Canoeists faced with the cumulative obstacles presented by the hydropower dams become similarly discouraged and abandon their efforts to migrate downriver.

In its PAD, the Licensee proposes no enhancements to mitigate the project effects on multiple-day canoe and kayak recreational use.

Issue #2: Rescuing Important Historical, Educational, and Cultural Records.

The Vernon Dam has a significant historical background. Vernon was the first to ship electricity overland to power distant mills. It is the oldest of the Connecticut River dams currently seeking new licenses.

The AMC has an active volunteer and staff educational program, and has an interest in the educational benefits that should be provided to the public by the hydropower operators on the Connecticut River. Informational signage and kiosks at project facilities should promote education about invasive species, water flows, the history of the area, who to call with problems, and what to do to get involved? Such educational improvements should be coordinated with recreational improvements.

This relicensing offers perhaps a last chance to rescue important historical records held by the Licensee related to the design and construction of the hydropower facilities as well as historical, pre-project conditions. A study should determine what historical records remain, make suggestions for their safe storage, how they can be made publicly accessible and suggest improvements at the project to highlight the historical significance of the facilities to the public.

Issue #3: Economic Health and Decommissioning.

Energy markets have changed dramatically in the past decade. The ownership turnover of energy facilities has been dramatic. Climate change may cause more frequent catastrophic and extraordinary events in coming years in the Connecticut River Valley. Tropical Storm/Hurricane Irene in 2011 washed out some portion of almost every state highway in Vermont except the Interstates. With the possibilities of millennial weather events occurring with much greater frequency and the ongoing dramatic changes in the competiveness of current energy generating sources, we believe that a study should assess the need for escrowed decommissioning funds or trust funds for all hydroelectric facilities currently up for new licenses. Many outdated and derelict dam removals today are coming at the expense of public dollars.

We recommend a study to determine the appropriate decommissioning costs at the end of this project's lifetime and how such costs should be funded in escrow in advance. In an age of international ownership, deregulation, changing ownership, and climate change, the financial health of ownership can be brought into jeopardy by distant events or by weather-related catastrophic failure of a dam. The public should not be burdened with decommissioning costs.

Study Requests

We hereby request three studies per 18 CFR 5.9(b).

1. Study of Project Facilities to Support Multiple-day Self-Powered Boating Trips on the Connecticut River.

(1) Describe the goals and objectives of each study proposal and the information to be obtained.

We recommend a study at the Vernon Project concerning the quantity, quality, and adequacy of land-based recreational facilities operated by the Licensee and associated with boating on the Connecticut River. This study should examine put-in and take-out facilities especially for canoes, kayaks, rowing shells and other self-powered watercraft; portage routes; campsites; parking and road access; seasons of operation of the facilities to match with actual river use; maintenance; water supplies and other amenities at campsites; and trash and sanitary facilities. The study should include a projection of usage during the proposed 30-year life of the licenses, and the opportunities for the project owners to buy land from willing sellers in order to increase recreational benefits.

The study should examine the facilities that are necessary specifically for canoe, kayak and rowing shell access to the river. Information provided by canoe clubs and other river recreational interests cite changing demographics and an increase in sea kayaking and rowing as reasons for the high interest in quiet water paddling and multiple-day trips. Most of the existing facilities were designed for day use by motorboats. Motorboat launch ramps are not particularly suited to self-propelled boats, especially those made of wood-and-canvas or fiberglass (e.g., sand works better than concrete).

Through-paddlers have complained about the portage at Vernon Dam. “That portage trail at the dam was not very good,” said one, but it was excellent compared to portages at other TransCanada dams. The difficulties are two. First, as another through-paddler said, “Getting out of the river just before the dam is a mess. I've done this 5 times and it's always a mess—junk in the cove, trash, etc.” Second, the pathway out of the river is steep and the landing is often muddy.

Paddlers who have attempted to follow the Connecticut River to the sea report that portages and camping can be difficult. Campsites can be few and far between. Islands are often posted as off-limits. Canoeing parties end up camping on mudflats and on isolated portions of private lands. A recent study by the Connecticut River Paddlers' Trail documented that the campsites operated by TransCanada would benefit from revitalization, and more regular maintenance, including the Stebbins Island campsite situated just below the Vernon Dam. In particular, sites should be regularly monitored and visited to ensure safe conditions for paddlers and to maintain the ecological integrity of the site, Competition for campsites is not uncommon, and the study might look at ways to minimize such conflicts. The Connecticut River Paddlers' Trail organization says the ideal frequency of canoe campsites is one for every five river miles, accompanied by canoe and kayak access in every town. The section of the river near the Vernon facility does not provide enough campsites to meet this standard.

Trails on both land and water should be studied. The Connecticut River Paddlers' Trail and the Connecticut River Birding Trail cross several project boundaries. Their interests should be part of a study framework that takes a watershed viewpoint, especially as it involves trail networks and associated facilities.

The ownership of project lands at the facility should be studied for recreational and conservation improvements. Some project lands could be added to existing park facilities, or placed under permanent conservation restrictions, in order to improve conservation and recreation. The study should evaluate the adequacy and maintenance of existing trail systems for the next 30 years, and determine opportunities for additional hiking trails on project lands, and for linking those trails to existing trails. Such trails in the watershed could cross project boundaries, and adding to them could involve requiring the Licensees to purchase additional land.

In association with this study, the creation of the Connecticut River and Watershed National Blueway should be taken into account, along with ways that the existing hydropower facilities can contribute to that effort. The study should take into consideration impacts on the entire watershed.

As part of this study, for example, a survey should seek to determine why people do NOT use this great public resource. The cumulative discouragement of recreation on the Connecticut River may displace use to other areas of the watershed. As with upstream migration of fish and downstream migration of canoeists, the survey might identify several discouraging aspects of project operations that could be corrected during relicensing.

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;

None of the three requesters is a resource agency. However, several state and federal agencies have an interest in recreation and conservation on the Connecticut River.

The states of Vermont and New Hampshire manage recreational sites in the vicinity of the TransCanada facility. There is a clear interest in the public's ability to traverse the Connecticut River in boats. The Connecticut River Atlantic Salmon Commission (CRASC), the Vermont Department of Fish & Wildlife (VT-F&W), the U. S. Fish & Wildlife Service (USF&W), and the National Marine Fisheries Service (NMFS) have a clear interest in the passage of anadromous and other migratory fish including shad, blue-back herring, eels and other species through fish ladders at the Vernon Dam. Although the federal Atlantic Salmon Restoration Program has been recently curtailed, some of the above agencies continue to study and promote the effective upstream and downstream passage of many endangered or threatened species.

Beyond the fisheries agencies, several federal agencies have an interest in recreation and conservation on the Connecticut River. On May 24, 2012, Secretary of the Interior Ken Salazar designated the Connecticut River and Watershed as the nation's first National Blueway. A Memorandum of Understanding signed in August 2012 by the departments of Interior, Agriculture, and the Army has as one objective "providing opportunities for scientific research, environmental education and outdoor recreation and access within the National Blueway to the extent compatible with agency missions." The National Blueway concept takes a watershed viewpoint and addresses the river from its source to the sea. The National Blueways System has as its goal "to advance a whole river and watershed-wide approach to conservation, outdoor recreation, education, and sustainable economic opportunities in the watersheds in which we live, work, and play." The National Blueway designation includes all the tributaries in the watershed and involves several federal and state agencies, including the U.S. Army Corps of Engineers, the Silvio Conte Refuge, U.S. Fish and Wildlife Service, the National Park Service, and the States of Connecticut, Vermont, New Hampshire, and the Commonwealth of Massachusetts, which have prioritized conservation, recreation, and restoration in the 7.2 million-acre Connecticut River Watershed.

(3) If the requester is a not resource agency, explain any relevant public interest considerations in regard to the proposed study.

The Vernon Dam creates an obstacle to public navigation and recreation on the river. Conducting the necessary studies and implementing the measures needed to ensure the public has access to quality outdoor recreational resources are in the public interest. It is widely accepted that outdoor recreation has significant benefits to participants including health, well being, and quality-of-life. Outdoor recreation also has proven economic benefits for communities located near recreational resources.

Improvement in opportunities for multiple-day canoe, kayak and rowing trips on the Connecticut River has the potential to offer the region significant economic benefits.

(4) Describe existing information concerning the subject of the study proposal, and the need for additional information.

There is an inconsistent body of knowledge regarding multiple-day trips on the Connecticut River. The PAD produced by the Licensee lists many facilities that are not owned or operated by the Licensee, including commercial operations that may have a temporary lifespan. There is a lack of consistency about those facilities in terms of their seasons of use and what amenities exist for public recreational use and their long-term protection.

Several publications are widely used by paddlers and recreationalists. The primary source of information is *The Connecticut River Boating Guide: Source to Sea* (3rd ed.) published by the Connecticut River Watershed Council (2007). Recreational maps and guides to the river have been published for some reaches by KM Digital Productions in South Hadley, Mass., and are available from the Connecticut River Watershed Council. These foldout river maps cover the reaches from Bellows Falls to Vernon, Vt. (2011), and from Vernon, Vt., to Turners Falls, Mass. (2008). The Connecticut River Birding Trail organization located in White River Junction, Vt., has published maps detailing the upper valley section, the northern section, and the southern section of the river.

The Connecticut River Paddlers' Trail organization has done a study that assesses the quality of campsites for the power company titled *TransCanada Hydro Northeast Connecticut River Paddlers' Trail Campsites*. The undated report examined campsites at Vernon and Bellows Falls and concluded that most were in "fair to good shape." Incidentally, the report also exposes the inconsistency and lack of maintenance at the project campsites. In 2013, the organization also published a Connecticut River Paddlers' Trail map of the river.

The Connecticut River Joint Commissions updated the Recreation Chapter of the Connecticut River Corridor Management Plan recently — there are six volumes, all posted online at: http://www.crjc.org/river-plan/recreation-management-plan/ The Upper Valley, Mount Ascutney and Wantastiquet plans will be most relevant as they each contain a section on boating for that section of the river.

(5) Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

Project owners have a responsibility to the public to provide adequate portage trails and facilities that promote public recreation on the river, including access points and campgrounds with necessary amenities. This study will be the defining mechanism for identifying additional sites that can best be adapted for increasing public access and multiple-day paddling trips on the Connecticut River. License requirements may include having the Licensee purchase additional property to provide camping, trail sites, portages or other facilities to assist the public.

The study may also identify indirect effects if the hydropower facilities and their projects have discouraged public use of the Connecticut River or displaced recreation to other parts of the watershed.

Cumulative effects need to be studied because it appears that the number of dams on the river discourage multiple-day trips and have fragmented the recreational experience. This study may result in license requirements or other mitigation for the Licensee regarding multiple-day trips on the Connecticut River.

(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

Studies of the adequacy of public resources are fairly standard in the planning field. Methodologies can be selected from among the recognized and accepted standards of the resource and public planning fields. Surveys of people who do NOT use the river or are displaced can employ randomized samples from several databases. Sufficient information is available from the guidebooks and maps of the river that identify access points and campsites, from the map done by the Paddlers' Trail, as well as information contained in the PAD, although such information needs to be updated with on-site visits. The sites evaluated should be operated or funded by the Licensee, not by others. Once a consultant is selected and approved, the information should be gathered and analyzed in a timely manner. The study would probably need a summer field season to locate river users for an adequate sample and visit the facilities. A consultant with experience in similar projects should be selected, in part to create relevant comparisons to other hydropower projects around the country.

The AMC has some staff expertise in this area because it operates facilities in the White Mountains, in Maine, and elsewhere in its chapters. We will work with the Licensee to document the known information regarding the river. We will provide volunteers and technical support for the studies when possible as appropriate. We hope to work collaboratively with the Licensee on this study.

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

There are several sites along the Connecticut River, private and public, that are used as access points or have camping facilities. However, vast differences exist in the ability or capacity of these sites to handle paddling groups with varying sizes or sanitation needs. Because there is no comprehensive guide or text that provides updated information, field inspection of existing sites should take place. Any needed reconstruction or rehabilitation of existing facilities should be identified. This analysis can be completed during any spring, summer, or fall field season. Such field research needs to be matched with projections of use in the future and with standard requirements for access sites, campsites, portages, sanitation facilities and other amenities. We know of no other method to acquire this information for evaluation.

2. Study of the Proper Presentation and Preservation of Important Historical Resources.

(1) Describe the goals and objectives of each study proposal and the information to be obtained.

Important historical records were kept from the construction of the Vernon dam, which went into service in 1909. The engineers who built this dam were highly skilled. They detailed the project with carefully drawn documents and many photographs of the land and the construction. These documents are now historical records and should be preserved.

We have an interest in the historical study of the river as it existed prior to the construction of the dams, including photographs of the natural riverbed. This will reveal what was lost during dam construction.

TransCanada has easy access to around 24 scrapbook volumes of these records and photos. Each volume is numbered, but the numbers suggest there may be a total of 300 or more scrapbooks in existence, some of which pertain to Vernon. A study should determine what historical records remain and make suggestions for their safe storage, such as in a secure location or a library. The Licensee has gone through multiple ownership changes in recent years and is now owned by a Canadian corporation. These records should be preserved before they are lost in transition.

We also have an interest in the educational opportunities for the public that should be provided by the project operators on the Connecticut River. Informational signage and kiosks at project facilities can and should promote education about invasive species, water flows, the history of the area, who to call with problems, and what to do to get involved? Existing data should be archived and be publicly accessible. These educational improvements should be coordinated with recreational improvements. These questions should be addressed in this study concerning the “proper presentation” and preservation of history.

Vernon Dam construction 1907.

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.

None of the three requesters is a resource agency. The AMC does keep a library of historical photographs and records at its headquarters on Joy Street in Boston. The tasks here are properly the concern of state historical preservation agencies.

(3) If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.

Historical records are a valuable public resource. For social, cultural and industrial historians, the records from construction of the Vernon Dam will become a valued scholarly asset. Vernon shipped electricity to the mills of Massachusetts and thus played a role in the labor history of the United States. The records should not be lost because of ownership transitions, neglect, or because their value may not be recognized by a corporate employee.

(4) Describe existing information concerning the subject of the study proposal, and need for additional information.

The need for additional information here involves the documents in possession of TransCanada related to the original construction of the Vernon Dam and to the original condition of the river.

(5) Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

Clearly the licensee has in its possession scrapbooks, photographs, construction plans, and other historical records related to the construction of the dam, or at least some surviving remnant of such documents. The nexus there is direct. Preservation of such documents should be a license requirement and they should be publicly accessible.

(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

Historians and librarians could recommend how to best handle and preserve the scrapbook records and other historical information about building the dam.

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

Most of the work in locating the records owned by TransCanada would be internal, with advice and recommendations coming from professional historians after the scope and location of the documents is known.

3. Study of the Economic Health of Ownership and Creation of a Decommissioning or Trust Fund.

(1) Describe the goals and objectives of each study proposal and the information to be obtained.

We request a study on the creation of a decommissioning fund or trust fund to protect the public interest. New England's rivers are littered with abandoned dams. Over the centuries, companies have failed, and weather events or human error have crippled dams that were then simply left behind. Energy markets and ownerships have been changing quickly.

A "perfect storm" event might breach a dam such as Vernon. Most of the Connecticut River dams are elderly facilities. Vernon is the oldest, dating from 1907-09.

Distant events, changing regulations, new energy sources, currency devaluations or unfortunate weather events could compromise the health of the current project. If something happened, the public should be insured against the burden of decommissioning costs. A study should recommend the terms of a license requirement for a decommissioning fund.

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;

We are unaware of the resource agencies' jurisdiction over decommissioning funds.

(3) If the requester is a not resource agency, explain any relevant public interest considerations in regard to the proposed study.

The economic security of a federally licensed hydropower dam on the longest river in New England is clearly in the public interest. Many hydropower projects support robust recreation economies and they produce a public good by generating renewable forms of electricity.

But the historical record demonstrates—by the thousands of abandoned dams on New England's rivers—that the public should not accept the burden of industrial failure any longer. It has become common to create decommissioning funds at such federally licensed facilities as a way of insuring the public interest against having to pay for removal of a damaged facility or to take over from a failed corporation.

(4) Describe existing information concerning the subject of the study proposal, and the need for additional information.

We are unaware of any published information on the economic viability of the individual dams, which may need to be studied under a non-disclosure agreement, or of the performance of decommissioning funds or other trust funds for this purpose.

(5) Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

There is a direct connection between Project operations and the economic viability of each individual dam. Study results could lead to a license requirement setting up an escrowed decommissioning or trust fund to protect the public interest.

(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

The financial viability portion of the study would follow normal procedures in accounting and financial management. The rules of trusts or decommissioning funds are well known.

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

The requested study would be relatively inexpensive. Funding the trust would be another matter. We are unaware of alternative means of securing the public from risks that the corporations or the physical assets might fail during the course of the federal license.

Conclusion:

We respectively request the multiple-day recreational, historical, and decommissioning studies for the Vernon Dam on the Connecticut River.

In addition, in these comments we offer our comments on the PADs, to better inform this relicensing process. Thank you for considering these comments.

Respectfully submitted this 28th day of February, 2013.

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Vernon Construction bypass site, 1907, at 55,000 cfs.

February 28, 2013
e-filing

The Honorable Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
Room 1A East 888 First Street, N.E.
Washington, D.C. 20426

Re: Electronic Filing: Appalachian Mountain Club, Vermont River Conservancy, and Friends of the Connecticut River Paddlers' Trail's Comments and Study Request for TransCanada Hydro Northeast, Inc.'s Bellows Falls Project (FERC Project No. 1855-045), Wilder Hydroelectric Project (FERC Project No. 1892-026) and Vernon Hydroelectric Project (FERC Project No. 1904-073).

Dear Secretary Bose:

Enclosed are the Appalachian Mountain Club (AMC), Vermont River Conservancy, and Friends of the Connecticut River Paddlers' Trail's comments and study requests for the above referenced proceedings, submitted by electronic filing and distributed electronically or by U.S. Mail to persons identified on the Commission's Service List for this proceeding. Please add those identified below as our respective organization's representatives to the Commission's official service list for this project. Thank you.

Sincerely,
Norman Sims (e-signature)

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Document Content(s)

P-1892-026
P-1855-045
P-1904-073
P-1889-081
P-2485-063

Comments from the **Appalachian Mountain Club**, headquartered in Boston, Mass., on riverwide issues in the proposed relicensing Connecticut River facilities.

2013 FEB 28 P 2:27

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Since 1876, the Appalachian Mountain Club has promoted the protection, enjoyment, and understanding of the mountains, forests, waters, and trails of the Appalachian region. It is the largest conservation and recreation organization in the Northeast with more than 90,000 members.

Riverwide issues: cumulatively effected resources and incremental effect of licensing the five Connecticut River projects with other past, present and reasonably foreseeable future actions within the Connecticut River Basin. Comments and suggestions on issues and alternatives to be addressed in the EIS and studies that will help provide a framework for collecting pertinent information on the resource areas.

The AMC's interests in hydropower relicensing are mainly in the areas of conservation and recreation. We want to help TransCanada and FirstLight in preparing their license applications by improving their contributions to conservation and recreation.

We have an interest in the creation of improved opportunities for multiple-day canoe and kayak trips on the Connecticut River. New England generally does not have a lot of opportunities for multiple-day canoe trips when compared to other regions of the country, with the exception of areas of northern Maine such as the St. John and Allagash Rivers, which are many hours from population centers. The Connecticut River runs from northern New Hampshire to Long Island Sound. It passes through several population centers and is easily accessible from all the major cities in New England with populations in the millions.

The most serious obstacles to multiple-day trips are the hydropower dams themselves. The existing portage routes around the dams are grossly inadequate, too long, and dangerous. For example, the Bellow's Falls portage route is 1.5 miles long and for much of that distance follows the breakdown lane of a high-speed state highway. The only portage around Turner's Falls comes from calling the power company and requesting a truck. Campsites are scarce in Massachusetts. Access areas are closed for much of the year.

We need a study of the facilities that are necessary for canoe access to the river. Most of the existing facilities were designed for day use by motorboats. The ramps and other facilities are not particularly suited to canoeists, particularly those using wood-and-canvas canoes. Campsites are sometimes completely filled up by parties that arrive in motorboats and stay for a week.

We recommend a study of the quantity, quality, and adequacy of the land-based facilities associated with boating on the Connecticut River. This interest involves all of the facilities that are being relicensed. The study should coordinate all the facilities even though there are two hydropower owners. Flow changes that benefit recreation might have a generational impact on all the dams lower on the river. This study should examine put-in and take-out facilities especially for canoeing and kayaking, portage routes, campsites, parking and road access, seasons of operation, maintenance, and sanitary facilities. The study should include a projection of usage during the 30-year life of the licenses, and the opportunities for the project owners to buy land in order to increase recreational benefits.

In association with the above study, a study of the creation of the Connecticut River and Watershed National Blueway should be done, along with ways that the existing hydropower facilities can contribute to that effort.

On May 24, 2012, Secretary of the Interior Ken Salazar designated the Connecticut River and Watershed as the nation's first National Blueway. A Memorandum of Understanding signed in August by the departments of Interior, Agriculture, and the Army has as one objective "providing opportunities for scientific research, environmental education and outdoor recreation and access within the National Blueway to the extent compatible with agency missions." The National Blueway concept takes a watershed viewpoint and addresses the river from its source to the sea. The National Blueways System has as its goal "to advance a whole river and watershed-wide approach to conservation, outdoor recreation, education, and sustainable economic opportunities in the watersheds in which we live, work, and play." The National Blueway designation includes all the tributaries in the watershed and involves several federal agencies.

The National Blueway engages several federal agencies including the U.S. Army Corps of Engineers, the Silvio Conte Refuge, U.S. Fish and Wildlife Service, the National Park Service, and the States of Connecticut, Vermont, New Hampshire, and the Commonwealth of Massachusetts, which have prioritized conservation, recreation, and restoration in the 7.2 million-acre Connecticut River Watershed.

Off-site mitigation for the loss of whitewater habitat by these four dams on the mainstem Connecticut River might take place on tributaries such as the West River, where the U.S. Army Corps of Engineers controls the flows. According to an MOU among Interior, Agriculture, and the Army signed in August, the Corps of Engineers "owns and operates 14 flood control dams and manages about 20,000 acres in the watershed to better manage the water supply, provide flood control and hydropower generation, and support recreation and environmental stewardship." Opportunities to engage these federal agencies and help them meet their obligations under the National Blueway System should be part of this study.

The Connecticut River Paddlers Trail and the Connecticut River Birding Trail cross several project boundaries. Their interests should be part of a framework that takes a river-wide viewpoint.

We have an interest in trails nearby and associated with project lands. A study should evaluate the adequacy and maintenance of existing trail systems for the next 30 years, and determine opportunities for additional hiking trails on project lands, and linking those trails to existing trails. Such trails in the watershed could cross project boundaries, and adding to them could involve requiring the Licensees to purchase additional land.

Document Content(s)

CITY OF LEBANON ~ PLANNING OFFICE

18CFR Section 5.9b
Submitted for the Wilder Hydro Electric Study Project, FERC 1892-026

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Comments referencing PAD Section 3.10 Recreational Resources and Section 3.12 Cultural Resources

The City of Lebanon requests that the Westboro Rail Yard be considered a part of the Wilder Dam "project" and added to the listing of recreational and cultural facilities in Tables 3.10-1 and 3.12-1. Located just a few hundred feet below the most southern point of the "project area" directly across from the confluence of the White River Westboro, this important facility is excluded from the PAD. Developing local and regional recreation and cultural resources at this site is mentioned in numerous local and regional studies including the CRJC Recreation and Water Management Plans (citations below), is consistent with the recently released 2013-2018 NH SCORP.

While the Westboro Rail Yard, a Brownfields site, is located slightly south of the Wilder Dam defined "project area", we believe that it is relevant to the Transcanada project and to Transcanada's commitment to supporting recreational and cultural facilities within its participating communities. We believe that this pivotal project provides an opportunity for a multi-jurisdictional effort including both public and private partnerships providing both land and river based recreation and cultural opportunities and assisting with revitalization efforts.

Introduction:

The Westboro Railroad Yard (Westboro) is located in downtown West Lebanon, New Hampshire approximately 3,000 feet south of the Wilder Dam and across from the mouth of the White River. Westboro was established in 1848 and was in continuous use for 120 years until the late 1970s. The yard was originally constructed by the Northern Railroad, which became part of the Boston and Maine Railroad in 1895. The Westboro Yard is a Lebanon landmark and has a considerable role in the economic history and future of the community. The Westboro Yard and roundhouse have been designated Historic landmarks by the Lebanon Historic District Commission. The Northern Railroad line, including the Westboro Yard has also been deemed eligible for the National Register of Historic Places as an historic district by the State Division of Historical Resources.

Early settlement in Lebanon concentrated along the Connecticut River in what is now West Lebanon, and along the Mascoma Lake region near Enfield. While Lebanon emerged as a mill-district and became the center of town, West Lebanon grew into a railroad hub with a separate identity after lines entered from Boston. This rail center would become known as Westboro after two trains collided when West Lebanon was mistaken for Lebanon.

Westboro consists of 22 acres bounded by one of the most beautiful stretches of the Connecticut River on one side and a significant portion of downtown West Lebanon business district on the other. The City of Lebanon and local civic groups have long sought to utilize portions of the Yard for recreational and cultural uses including a park, car-top boat launch, a community facility for public events and interpretation and a riverfront trail for walking and bicycling. This trail will extend the full length of the rail yard and will connect Westboro to the City's existing trail system.

Brownfields:

The Yard was purchased by NH DOT in 1999 for anticipated future rail uses and in 2000 the state granted a 10 year lease to the Claremont Concord Railroad to operate a rail-cement facility on one portion of the Yard, that permit was renewed in 2010. Extensive contamination has been documented at various locations throughout Westboro Yard including on the banks of the Connecticut River itself. There are a number of monitoring wells on the property though the full extent of the contamination around the historic buildings is still unknown. Based on the historic use of the site by steam trains as opposed to electric, our hope is that the types of contamination present are likely consistent with oil, petroleum and asbestos rather than PCBs. A Brownfields Level I and Level II will be needed to ascertain the full extent.

Between 2005 and 2009, in a joint project with the New Hampshire Department of Transportation (NHDOT) and the New Hampshire Department of Environmental Services Brownfields (NHDES) program, the City of Lebanon remediated contamination at the north end of the yard and took ownership of a small parcel of land abutting the Route 4 Bridge. In 2014 and 2015, NHDOT will be replacing the Route 4 bridge and removing the temporary bridge currently located on the city owned property a leaving a small park. Facilities will include trailhead parking car-top boat launch, interpretive panels, a picnic area and possibly a fishing pier.

The New Hampshire Department of Environmental Services continues to monitor the yard and is conducting additional studies in the area around the roundhouse. For this Brownfields site to be used for public recreation the land will need to be transferred to the City of Lebanon and an extensive clean-up effort will be necessary. The City is working with NHDOT and NH DES to explore options.

Nexus:

While the Westboro Rail Yard is located slightly south of the Wilder Dam defined "project area", we believe that it is relevant to the Transcanada project and to Transcanada's commitment to supporting recreational and cultural facilities within its participating communities. We believe that this challenging project provides an opportunity for a multi-jurisdictional effort including public and private partnerships and investment to develop land and river- based recreation, increase cultural opportunities and support revitalization efforts. The City would welcome the opportunity to work with Transcanada to that end.

The City of Lebanon is concerned that Transcanada's Wilder Dam operations which result in the artificial raising and lowering of water levels and changes in velocity in the Connecticut River combined with increased flow from the White River is possibly accelerating the erosion process and may be eroding the contaminated river bank along the Westboro Rail Yard. Further, despite the remediation of the Tidewater parcel at the north end of the yard, there is still a plume of contamination emanating from a gasoline spill at the old T & R Sidings facility to the north across Bridge Street which runs under the property in a south westerly direction towards the Connecticut River. We suspect the changes in velocity and raising and lowering of the water levels increases capillary action drawing contaminants toward and into the Connecticut River at a rate faster than normal attenuation. The City has advised the New Hampshire Department of Environmental Services (NH DES) of these concerns and DES continues to study the contamination in the yard particularly in the area of the roundhouse and along the river bank.

The current approach to dealing with the contaminants in the yard is attenuation; given the city's intent to repurpose portions of the yard to include public use and river access which will likely involve a transfer of property, a Brownfields Level I and level II study will be necessary and should include a study correlating the dam operations with contaminant levels shown in monitoring wells.

The City's vision for the south end of the yard includes an amphitheater and interpretive center to celebrate the river and railroading history of West Lebanon and to reconnect Westboro with the downtown. The yard is visible from many locations on both sides of the Connecticut River. Unfortunately the deterioration associated with the derelict historic railroad buildings contribute to an aura of blight and decay permeating the downtown, overshadowing attempts to revitalize West Lebanon and generate new investment. Despite the efforts of the local civic groups, each year the yard gets shabbier and the historic buildings come one step closer to collapsing. West Lebanon has little green space or public areas, gaining access to and redeveloping at least a portion of the Westboro Yard is essential to the re-vitalization of this struggling downtown. The irony is not lost that the thriving railroad yard that once contributed to the expansion of West Lebanon is today the symbol of neglect.

The need for this recreational and cultural facility is already supported by numerous studies and plans. The project is listed in the City of Lebanon Master Plan, Recreation Plan, and Strategic Plans as well as being referenced in the CRJC Recreation and Water Resources Plans, goals and recommendations including:

CRJC Water Resources Plan

- The City of Lebanon and the local Rotary Clubs should continue to pursue redevelopment of the Westboro Rail Yard, including a riverside path and a car-top boat launch.

- Encourage additional car-top boat access for the use of canoes and other small craft, on the mainstem and on tributaries, because of their low impact on the river.

- Assist towns in creating bike paths; promote the use of abandoned railroad rights-of-way as bike paths while continuing to permit landowners to access their land across tracks.

- Identify opportunities, when land use is changed, to retain easements for public access for trails, birding, car-top access, or other low impact public recreation.

- Explore federal and state funding programs, such as SAFETEA, to create trails and other new recreation opportunities.

CRJC Recreation Plan – Upper valley River Subcommittee

- Some of the most interesting paddling in the Upper Valley segment is in the five miles below the dam and past heavily developed West Lebanon, where foliage on the riverbank largely spares the paddler a view of the commercial strip close to the river, and the forested Vermont bank and riffles at Johnson Island fill the scene. The City of Lebanon and the local Rotary Clubs are considering a plan to create recreational trail and car-top boat access in West Lebanon's historic Westboro Rail Yard.

- Lebanon looks forward to a new public car-top river access, trail, and river overlook in or near historic downtown West Lebanon. While plans have been proposed for the amenities at the historic Westboro Railyard for several years, progress has been stalled by soil contamination, ownership issues, funding, and the question of compatibility betwwen public recreation and active rail operations onsite. The city's recent receipt of a DES brownfields grant bodes well for petroleum cleanup and eventual establishment of river access. The City of Lebanon and the NH Bureau of Rail & Transit should continue working with all stakeholdrs to provide public recreational acess in West Lebanon that enhances the downtown and provides stewardship of the river.
- Northern Rail Trail - Twenty-five miles of a former 59 –mile rail trail from Lebanon to Boscawen have become a trail through the efforts of local volunteers, and another 34 miles are under development. Abandoned railroad rights-of-way can serve as bike paths as long as abutting landowners' access remains. For part of its route, the trail follows the Mascoma River. The trail is open for hiking, horseback riding, bicycling, snowmobiling, cross-county skiing, and dog-sledding.
- A potential pedstrian and bicycling connection between Lebanon and White River Junction exists across the railroad bridge linking these two communities (note that a marsupial bridge is now under consideration).

Trails Connector:

The Mascoma River Greenway (MRG) is referenced above in the CRJC Upper Valley River Subcommittee Recreation plan; this four mile long section of the Northern Rail Trail terminating at the Westboro Rail Yard, is the highest recreation and transportation priority for the City of Lebanon. Following the former Boston and Maine corridor from the Lebanon/Enfield Town line to the Westboro Railyard in West Lebanon and, ultimately, to Vermont, the Northern Rail Trail has been named one of the top 100 trails in the United States. In addition, the beautiful Mascoma River winds itself back and forth across the trail all the way to its final destination, the Connecticut River. The strategic east-west alignment of the Northern Rail Corridor provides this unprecedented opportunity to create a scenic, multi-use path running the entire breadth of the city. The MRG will be the core transportation corridor for bikes and pedestrians through the heart of Lebanon and West Lebanon, connecting Lebanon's neighborhoods with workplaces, schools, child care center, open spaces, shopping areas, a medical center and transit stops.

The MRG can take on a greater transportation role in Lebanon accommodating commuting, school, and other non-work trips in addition to recreational uses. Linkages into the Greenway from the City's bike and pedestrian network are located at several junctions along the Greenway and include the String of Pearls, the Riverside Community Park, the Memorial Pool and the Upper Valley Loop Trail which provides trail connections to the central Upper Valley towns of Lebanon, Hanover, Hartford, and Norwich as well as a connector to the State of NH north-south bicycle route.

Consultation:

The City of Lebanon met on February 20, 2013 with NH DOT Bureau of Rail and Transit and the NH DES Brownfields program to review the status of the southern portion of the yard where the City envisions access to the yard from Route 12A dry bridge, an amphitheater and parking as well as a riverfront trail which will connect with the small park at the north end of the yard. A marsupial bridge under the existing Connecticut River rail bridge would connect the Park (name to be determined) with trails on the Vermont side of the river.

Studies:

In additional to the related request to study the impact of the flow and capillary action on this Brownfield’s site, a number of studies are needed: an engineering study to assess the status of the rail buildings including the round house, the bunk house and the sand shed, and a Level 1 and Level II brownfields assessment for the area of the yard needed for the project. The City expects to apply to NH DES and the US EPA for the Brownfields Assessments.

Funding:

Beyond that we anticipate that funding will be needed to assist with Brownfields clean-up, demolition of the structures (which we believe at this point are not salvageable), construction of a new facility and development of interpretive materials; and finally, construction of the riverside trail to connect to the north end of the yard. To date, we have raised funding to complete the Plan for the yard (LCHIP), the remediation at the north end of the Yard (over $700,000) was funded by the NH DOT and the NH DES Brownfield’s grants, the City has funded the development of plans for the park at the north end of the yard and is applying for LWCF funds to complete the Park.

Though the City continues to work with stakeholders and will continue to submit grant applications, a project of this magnitude cannot be accomplished without capital infusion from multiple partners. The City of Lebanon requests that a Mitigation Enhancement fund be established for recreation and cultural facilities needs and that the Westboro Rail Yard be considered a part of the “project”.

Document Content(s)

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COMMISSIONS
I N C

March 1, 2013

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E., Room 1A
Washington, DC 20426

RE: Comments on Integrated Licensing Process and Study Request for FERC project numbers P-1904 (Vernon), P-1855 (Bellows Falls), P-1892 (Wilder), 1889 (Turners Falls), No. 2485 (Northfield Mountain).

Dear Secretary Bose:

The Connecticut River Joint Commissions (CRJC) is comprised of New Hampshire's Connecticut River Valley Resource Commission (CRVRC) and Vermont's counterpart, the Connecticut River Watershed Advisory Commission (CRWAC). Each commission was created by its respective state legislature and directed to cooperate to preserve and protect the resources of the Connecticut River and its watershed.

In 1992, the New Hampshire Legislature designated the Connecticut River into the New Hampshire Rivers Management and Protection Program pursuant to NH RSA 483. Upon designation, CRVRC was appointed the local river management advisory committee for the Connecticut River to work with the CRWAC "to consider and comment on any federal, state or local governmental plans to approve, license, fund or construct facilities that would alter the resource values and characteristics for which the river or segment is designated."

The Connecticut River possesses a variety of significant federal, state and local resources which qualified it for designation into the Rivers Management and Protection Program. These resources were inventoried in the 1991 nomination document prepared by CRVRC. Aided by bi-state subcommittees of riverfront town representatives, CRJC developed and adopted its Connecticut River Corridor Management Plan in 1997, and published amplified plans for Water Resources and Recreation in 2009. The corridor management plans contain recommendations to protect the multiple uses and resources of the river and its watershed..

CRJC has reviewed the Preliminary Application Documents and Scoping Documents for the relicensing of the following hydropower projects:

- Wilder Dam (Wilder Project No. P-1892)
- Bellows Falls Dam (Bellows Falls Project No. P-1855)
- Vernon Dam (Vernon Project No. P-1904)
- Turners Falls Dam (Turners Falls Project No. 1889), and
- Northfield Mountain Pumped Storage Project (No. 2485).

On the basis of the Legislature's designation, the nomination document, and the three plans cited above, CRJC wishes to provide comment on how the Federal Energy Regulatory Commission's relicensing of these five projects may affect the resources of the Connecticut River and its watershed. This review is included as Attachment A.

Attachment B contains a study request by the Connecticut River Joint Commissions for a watershed-wide stormwater model to:

1. assess the effect of dam operations, under current flow conditions and future conditions when more extreme weather events are anticipated, on public interests; and
2. recommend measures to manage stormwater through dam operations to protect, preserve and enhance public interests.

Sincerely,

Rebecca Brown
President

Attachment A:

Resources of the Connecticut River Watershed and Potential Impacts on these Resources by Relicensing of the Wilder, Bellows Falls, Vernon, Turners Falls and Northfield Mountain Projects

Natural Resources:

The Connecticut River designation documents and subsequent river corridor management plans recognize a number of state and federally-listed rare, threatened and endangered (RTE) species in the Connecticut River and its banks, including the dwarf wedge-mussel and Jesup's milk vetch populations between Wilder Dam and Bellows Falls, the cobblestone tiger beetle, and the round whitefish. The Atlantic salmon restoration project was also recognized. In addition, the Connecticut River is home to numerous exemplary natural communities along the river's edge – floodplain forests, riverside seeps and outcrops (where Jesup's milk vetch grows), calcareous wetlands, and steep, rocky cliffs. The Connecticut River serves as a migratory corridor for waterfowl, hawks and songbirds. The operation of Wilder, Bellows Falls and Vernon Dams causes fluctuating water levels that can cause erosion and degradation of riverside habitat and natural communities, as well as alteration of aquatic habitat, including the mainstem, tributaries and backwaters or "setbacks", on which aquatic species and migratory waterfowl rely.

The Connecticut River designation documents and subsequent river corridor management plans emphasized the valuable open space in each town along the river. This open space includes riverside lands and islands owned by New England Power (now TransCanada), e.g. at Wilder Dam in Hartford and Lebanon, Sumner Falls in Hartland, farmland in Charlestown, Rockingham and Springfield, Upper Meadows and Herrick's Cove in Springfield, setbacks and islands above Vernon Dam in Hinsdale and Vernon.

Managed Resources:

The Connecticut River's water is used in many ways. In addition to the hydropower operations at Wilder, Bellows Falls and Vernon Dams, river water is used by farms for irrigation and by wastewater treatment plants in Lebanon, Charlestown, Hartford, Windsor, Bellows Falls, and Brattleboro. The designation process identified concerns for the adequacy of water quantity, specifically with respect to the demand for new and expanded water withdrawals in the future, in New Hampshire, Vermont and Massachusetts.

Cultural Resources:

Several Archaic and Woodland archeological sites are located on the banks of the Connecticut River and several tributaries – specific mention is made of sites in Hanover, Claremont, West Chesterfield, Hinsdale and sites on terraced banks of Connecticut River in Orford, Plainfield, Charlestown, Walpole and North Walpole. Historic resources on the river include Porter Cemetery in Lyme, Gilman Island in Hanover, site of old mill at Wilder Dam in Hartford, original village site of Lebanon, Mast Camp in Cornish, an historic settlement at the confluence of Blow-me-down Brook in Cornish, Hubbard and Jarvis Islands in Claremont, Fort at No. 4 in Charlestown, and a recreational boat club near Bellows Falls-North Walpole bridge. Also historic ferry crossings are located in Norwich, Hanover, Weathersfield, Claremont, Putney, Westmoreland, Dummerston, Chesterfield, Hinsdale and Vernon.

Current-day community cultural resources include several attractions on the river, including the Montshire Museum in Norwich, Ledyard Canoe Club in Hanover, Lyman Point Park in Hartford, Cornish-Windsor Covered Bridge, Fort at No. 4 in Charlestown, and the fish ladder at Vernon Dam. Bass tournaments and fishing derbies are important cultural events.

Recreational Resources:

The Wilder Dam, Bellows Falls Dam and Vernon Dam impoundments, including the bays and setbacks above Vernon Dam, serve as a warmwater fishery and boating resource. Fishermen access the river primarily by boat, but there are many fishing spots on the banks, as well as ice fishing. Fishermen also fish in free-flowing sections of the river: in the eddy at outwash of Wilder Dam, near 1-89 bridge in Hartford and West Lebanon, and below Bellows Falls and Vernon Dams.

The Wilder Dam impoundment was reported as a very popular boating spot, with the 1991 nomination document noting that boat launch parking lots were full on weekends. There is diversity in the types of boats used in these areas - canoes, fishing boats, party boats, speedboats, plus rowing shells, canoes and kayaks from Ledyard Canoe Club, also tubing, water skiing in wider parts of the river. Below Wilder Dam to Sumner Falls, the river can be very shallow, which limits recreation to mostly canoes, but is still well-used. Sumner Falls offers a portage around the falls, as well as an opportunity for whitewater canoeing and kayaking; below the falls, powerboats and canoes are typical. Between Bellows Falls and Vernon and then below Vernon Dam, there is again diversity in the types of boats used: pleasure boats, jon boats, water ski boats, canoes and rowboats, with canoes and rowboats accessing the shallow back inlets.

The 1992 designation recognized that canoeists engaged in day trips as well as longer trips by staying at different inns along the river. In the years following, the Connecticut River Paddlers' Trail has developed, allowing canoeists to camp at designated sites along the river in New Hampshire and Vermont. The 2009 Recreation Management Plan, part of the Connecticut River Corridor Management Plan recommends that TransCanada maintain their property to continue to provide campsites at Gilman Island, Lower Meadow, Stebbins Island and Wantastiquet/Hinsdale, portage trails around the dams, and public river access at Sumner Falls and Herrick's Cove.

Potential Impacts on Resource Values:

Fluctuating water levels: The fluctuation of water levels due to dam operations may impact instream and riparian biological communities and rare, threatened and endangered (RTE) species through bank erosion, flooding and drought. Dam operations may also alter spawning and feeding habitat upon which aquatic species and migratory waterfowl rely. Furthermore, fluctuating water levels may affect many other uses, from the experience of boaters and fishermen to archaeological, historic and cultural resources on the banks.

The 2009 Water Resources update of the Connecticut River Corridor Management Plan recommends that "dam owners should thoroughly evaluate impacts of impoundment cycling on riverbank erosion as part of relicensing studies, and undertake mitigation as appropriate." CRJC supports requests submitted by resource agencies to study the effect of water level fluctuations on public interests.

Water quantity: The Connecticut River's designation recognized the need for the dams to maintain minimum flows when they are not generating power. Participants in the designation process raised concerns over the allocation of water, specifically with respect to the future. Furthermore, the designation of the river into the Rivers Management and Protection Program statutorily requires the establishment of instream flows to support a variety of public interests (e.g., fisheries, water quality, recreation, power, scenic values, etc).

CRJC is submitting a study request (Attachment B) for a watershed-wide stormwater model that will provide a methodology to optimize dam operations, during existing and projected future flows, to ensure the availability of water for uses that include:

1. maintenance of natural communities including wetlands, flood plains and fish and wildlife habitats;
2. promotion of human uses such as water-based recreation and agriculture, and
3. society's needs for water supply, waste water assimilation, flood control, hydropower generation.

Water quality: The designation recognizes the resource values of aquatic RTE species, the warmwater fishery and recreational uses, which are all dependent on clean water. Dam operations may impact river water quality, especially in the future when more extreme weather events and flows are anticipated. Of particular concern is sediment and pollutant transport, water temperature, dissolved oxygen and turbidity. Therefore, CRJC supports the study requests submitted by state and federal resource agencies that propose to study the effect of dam operations on water quality with respect to these uses and other public interests.

Recreation: The designation recognizes the effect of dam operations on recreational values of the river, specifically fishing for warmwater species and boating of many types. It should be noted that all reaches of the river are used for recreation, both impoundments and free-flowing reaches below the dams. The 2009 Recreation update of the Corridor Management Plan makes several recommendations to maintain recreational opportunities. These include maintaining existing portage trails, campsites and public access points, and improving safety to ensure enjoyable recreational experiences. Specific recommendations to improve safety include providing:

- signage at Sumner Falls,
- notices at boat ramps regarding draw down of the Bellows Falls impoundment, and
- signage that calls attention to boat speed regulations, bank erosion, nuisance aquatics and boater responsibilities.

Recreational uses are largely dependent on water levels controlled by the dams and the management of lands owned by TransCanada. The land holdings provide access points to the river and recreational sites. CRJC supports study requests submitted by state and federal resource agencies that propose to study the effect of dam operations and land management by the licensee on recreational uses, particularly with respect to providing safe experiences for users. CRJC would like to emphasize the fact that the Local River Subcommittees composed of citizen representatives from riverfront communities possess extensive local knowledge of existing recreational uses. Thus, the CRJC recommends that the local river advisory committees be consulted as a resource in the assessment of alternative land management and river flow proposals on recreational uses.

Attachment B:
Study Request for Watershed-wide Stormwater Model

1. *Goals, Objectives and Required Information*

Goals:
(1) Take a cumulative watershed approach to the management of surface water, a public trust resource;
(2) determine the effect on public interests from projected future stormwater flows and the operation of the dams; and
(3) recommend measures to manage stormwater flows through the operation of the dams to protect public interests.

Objectives:
(1) Identify public interests in the watershed that have a nexus to dam operations,
(2) develop an integrated, sharable, and scientifically-rigorous stormwater model for the entire watershed,
(3) assess the cumulative effect of the dams on public interests, and
(4) recommend license conditions to protect, preserve and enhance public interests.

Required Information:
(1) High resolution base maps from LiDAR (Light Detection and Ranging) imagery of the watershed north of the Turners Falls Project (Exhibit 1), with LiDAR data collection recommended at Quality Level 2 as defined by the National Enhanced Elevation Assessment.

Elevation Quality Levels (QL)	Source	Horizontal Resolution Terms			Vertical Accuracy Terms	
		Point Density	Nominal Pulse Spacing (NPS)	DEM Post Spacing	Vertical RMSEz	Equivalent Contour Accuracy
QL 1	LiDAR	8 pts/m^2	0.35 m	1/27 arc-sec ~1 meter	9.25 cm	1-ft
QL 2	LiDAR	2 pts/m^2	0.7 m	1/27 arc-sec ~1 meter	9.25 cm	1-ft
QL 3	LiDAR	1 – 0.25 pts/m^2	1 – 2 m	1/9 arc-sec ~3 meters	≤18.5 cm	2-ft
QL 4	Imagery	0.04 pts/m^2	5 m	1/3 arc-sec ~10 meters	46.3 cm – 139 cm	5 – 15 ft
QL 5	IFSAR	0.04 pts/m^2	5 m	1/3 arc-sec ~10 meters	92.7 cm – 185 cm	10 – 20 ft

(2) land uses and characteristics in the watershed, and
(3) locations and assessments of existing and future public interests (e.g., fish habitats, archaeological and historic resources, actual and potential pollutant releases, farmland, wetlands, recreational locations, flood plains, water withdrawals, etc.).

2. Resource Management Goals

Develop a rigorous stormwater model (model) that incorporates the precise location and elevation of each public interest resource to enable an assessment of the effects of dam operations under a number of different stormwater scenarios. These analyses may be used as the basis for assessing the effect of dam operations, determining *cumulative impacts* and identifying potential *compensatory mitigation measures*.

The model may be used to (1) inform coordinated operations of main stem and tributary dams to regulate normal flows in order to reduce adverse effects and enhance beneficial effects on public interests, (2) predict future low and high water flows, based on a range of precipitation events, and (3) modify dam operations to lessen impacts during extreme precipitation events on specific resources.

Furthermore, the model may be used for emergency planning if, for example, during a severe storm event there is a catastrophic dam breach, the model could be used to predict the extent of downstream flooding.

3. Public Interest Considerations

The Connecticut River Joint Commissions are requesting this study. The public needs to know the effect the dams and their operations have on our natural and human environment, particularly in the decades ahead when precipitation is expected to be more extreme than in prior decades. They also need to know if and how the dams can be operated to benefit public interests in addition to hydropower.

The dams are the most significant factor in regulating stormwater flows in the mainstem of the river. They create detention ponds that collectively extend for more than a hundred miles in length between Vermont and New Hampshire (Exhibit 2). They slow the velocity of the water and promote the deposition of sediment and pollutants. They also play an important role in providing recreational opportunities, desynchronizing flood flows, diluting toxic discharges, and sustaining instream and riparian habitats.

A diversity of water users need access to timely, accurate, reliable data in order to determine anticipated availability of water for the maintenance of natural communities including wetlands, flood plains and fish and wildlife habitats, for the promotion of human uses such as water-based recreation and agriculture, and for society's needs for water supply, waste water assimilation, flood control, hydropower generation, and other uses that can be anticipated over the forty-year time period of the forthcoming licenses.

4. Existing Information and Need for Additional Information

Existing data on the location of resources of concern, while well-intentioned, are too often incomplete or inaccurate. Since instream and riparian uses are closely tied to the frequency, depth and duration of the inundation by the river, stormwater information needs to be modeled and modernized, as precisely as possible, for accurate application.

For example, the dams currently coordinate with the United States Army Corps of Engineers to provide flood control. However, a model needs to be developed that will accurately predict flooding from storm events that are projected to be more frequent and intense than the historical pattern. The Northeast has experienced a greater increase in extreme precipitation over the past few decades than any other region in the United States. Between 1958 and 2010, the Northeast saw a 74% increase in the amount of precipitation falling in very heavy events (http://ncadac.globalchange.gov). Recent flooding events in Vermont and New Hampshire highlight the issue.

Moreover, better elevation data needs to be acquired to more accurately predict the extent of flooding during storm events. The accuracy of the floodwater extent portrayed on Flood Insurance Rate Maps (FIRM) varies with the accuracy of the digital elevation model used to simulate the land surface. During tropical storm Irene areas in our bi-state region were flooded that were not within a mapped flood plain whereas other areas escaped the floods even though they had been depicted clearly within a mapped floodplain. Irene and other storms have highlighted the fluvial erosion risks throughout the watershed, and how management of streams and rivers throughout the watershed have exacerbated those risks. Better understanding stream and river geomorphology, including the extent to which streams and rivers have lost access to their floodplains due to incision, is critical to understanding the hydrology of the watershed, including updated model of low and high flow events. Better elevation data is needed for the entire watershed. A recently published report by the National Academy of Sciences, *Elevation Data for Flood plain Mapping, 2007* highlights the deficiencies of available land surface elevation data.

5. Nexus between Project Operations and Development of License Requirements

Stormwater flows in the river effect nearly every resource under study, from providing white water recreational activities to sustaining flood plain biological communities. The operation of the dams, in which they impound and then release the water, relies entirely on available stormwater. Integrated, accurate information about storm frequency, precipitation intensity, topography and land uses in the watershed is essential to allocate water for specific uses and, at the same time, maintain acceptable water quality standards.

A model with precise elevation data will help us better assess potential effects on all our resources and then develop appropriate mitigation measures for those effects. For example, riverbank erosion, with its attendant loss of land and accumulation of sediment is a costly and prevalent problem on the reaches of the river affected by flow modification from the dams. A refined model will (1) allow a better understanding of the causes and effects of riverbank erosion and (2) assist in identifying measures to mitigate the problem. Mitigation of erosion and other effects should be an important component of eventual dam license provisions.

A rigorous model is essential so that license permit conditions can be developed to protect river resources through coordinated management of the dams. The challenge will be to identify and designate specific uses for each reach of the river and to identify and regulate specific flows in each of these reaches to ensure that designated uses are not degraded, and where feasible can be enhanced as a consequence of the impoundment and release of flows by the dams.

6. Proposed Study Methodology is the Preferred Scientific Practice

The watershed approach to analyzing water flows is the preferred methodology for forecasting flows, and evaluating environmental and economic outcomes based on various dam management scenarios. This approach is being utilized in the Connecticut River Watershed Restoration project that is being undertaken by the Nature Conservancy, United States Army Corps of Engineers New England District Office, University of Massachusetts Amherst, and United States Geological Survey. This study is being performed to help determine how management of large mainstem and tributary dams and water systems can be modified for environmental benefits while maintaining beneficial human uses such as water supply, flood control and hydropower generation.

The use of airborne LiDAR technology is the preferred methodology for the preparation of digital elevation models. Coastal studies, in progress, are using LiDAR imagery to interpret the effect of sea level rise due to climate change are on our coast lines. The Northeast LiDAR Project is a collaboration between a number of agencies to acquire accurate, high-resolution LiDAR data for coastal areas of New York, Connecticut, Rhode Island, Massachusetts, New Hampshire and Maine (www.ma.nrcs.usda.gov/technical/lidar/index.html).

Moreover, scientists at the University of New Hampshire are using LiDAR data to model potential future inundation areas in the Lamprey River watershed based on projections of land use changes and increased precipitation (http://www.unh.edu/news/cj_nr/2012/may/ds16landscape.cfm#ixzz2LuUVDFLF). Furthermore, the New Hampshire Geographic Information System (GIS) Strategic Plan points out that airborne LiDAR technology is recommended as the preferred method for acquiring data of sufficient accuracy and resolution for the assessment and management of water resources (Exhibit 3).

7. Cost of Proposed Study and Relationship to Other Studies

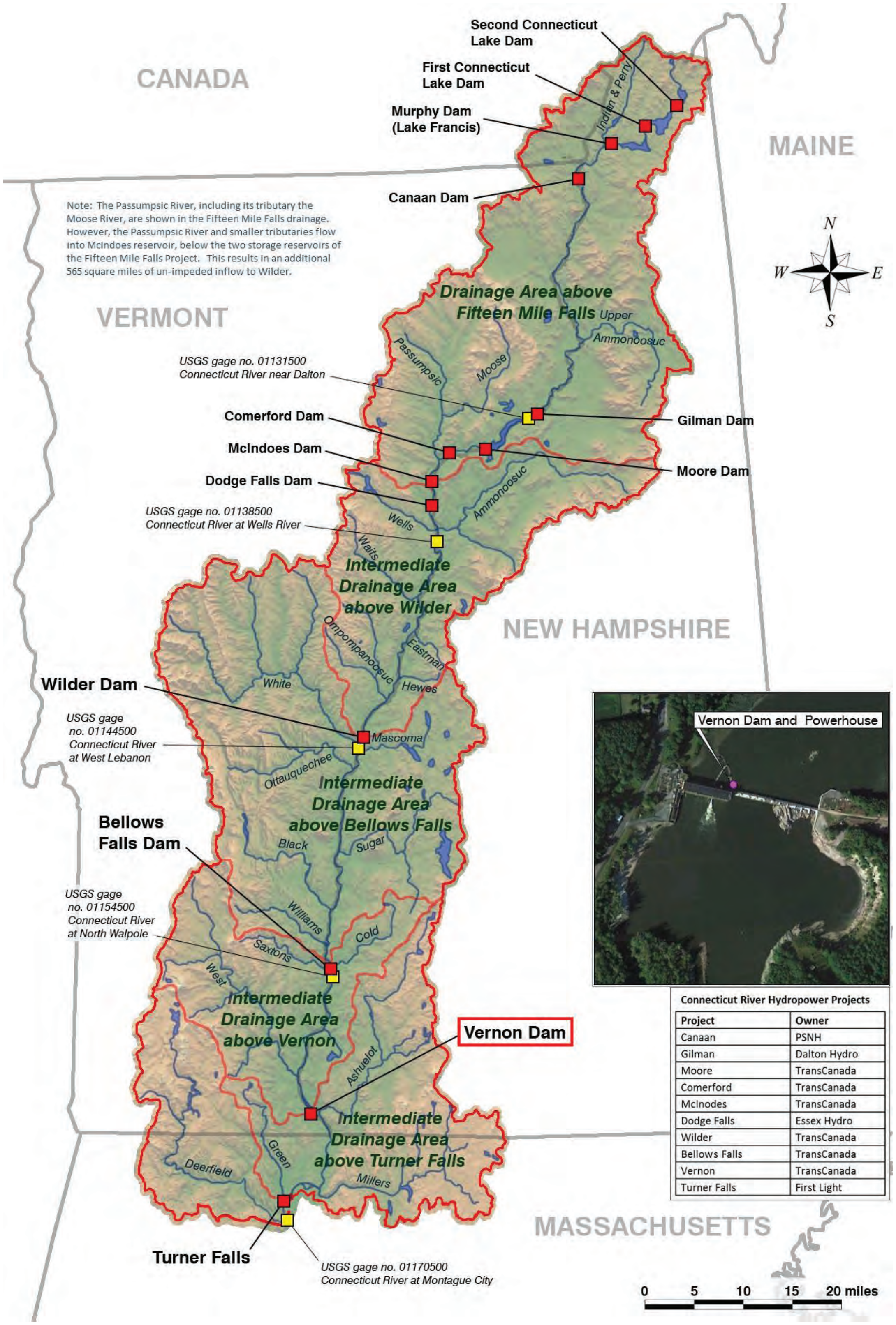
To our knowledge, none of the other proposed studies suggest LiDAR mapping be undertaken and a stormwater model be developed for the entire watershed. Existing hydrological studies lack precise elevation data and are based on historic United States Geological Survey gage data. The historic record will be of limited usefulness in predicting flows under the changed climate regime of the decades subject to the new permit.

The model we propose, utilizing LiDAR, will have much more precise elevation data and will incorporate land uses, topography, cover types and other characteristics within the entire watershed. This will be a refined tool that may be used to better predict the timing and quantity of future flows and to some extent address issues related to water quality (e.g., identify the locations of pollution discharges that could become incorporated in storm flows).

Moreover, we anticipate specific agencies will request the preparation of high-resolution maps and assessments of resources under their jurisdiction. For example, we expect federal and state resource agencies responsible for protecting wetlands will request the delineation and assessment of wetlands bordering the mainstem. We also expect other resource agencies will request bathymetric studies of the river channel to assess instream habitats. Together, these studies and the proposed stormwater model will provide the basis for identifying measures to reduce adverse effects and compensate for unavoidable ones.

Development of the proposed stormwater model utilizing LiDAR data could cost two million dollars or more. Amortized over the life of the permits this puts a yearly cost at about $50,000. Moreover, we strongly argue that the model be shared with cooperating agencies, the LiDAR data be made available, i.e. in the public domain, and the specifications for the LiDAR data collection are adequate for broad uses of the data. As such we might anticipate the cost will also be shared among these agencies which could include National Oceanic and Atmospheric Administration, United States Environmental Protection Agency, United States Fish and Wildlife Service, United States Army Corps of Engineers, Federal Emergency Management Agency, United States Geological Survey, and state resource and transportation agencies and academic institutions in Massachusetts, Vermont and New Hampshire. NH GRANIT, New Hampshire's state GIS clearinghouse, has reviewed and supports this request, and furthermore has the capacity to disseminate and archive the LiDAR data for use by the licensees, the potential funding agencies involved in cost-sharing and the public at-large.

EXHIBITS:
Exhibit 1. Watershed Map.
Exhibit 2. Operations Summary.
Exhibit 3. An Enhanced Statewide Elevation Dataset for New Hampshire: The Case for LiDAR.



Connecticut River Hydropower Projects

Project	Owner
Canaan	PSNH
Gilman	Dalton Hydro
Moore	TransCanada
Comerford	TransCanada
McInodes	TransCanada
Dodge Falls	Essex Hydro
Wilder	TransCanada
Bellows Falls	TransCanada
Vernon	TransCanada
Turner Falls	First Light

Figure 3.2-1. Project and the upper Connecticut River Basin (Source: EPA, 2012, as modified by TransCanada).

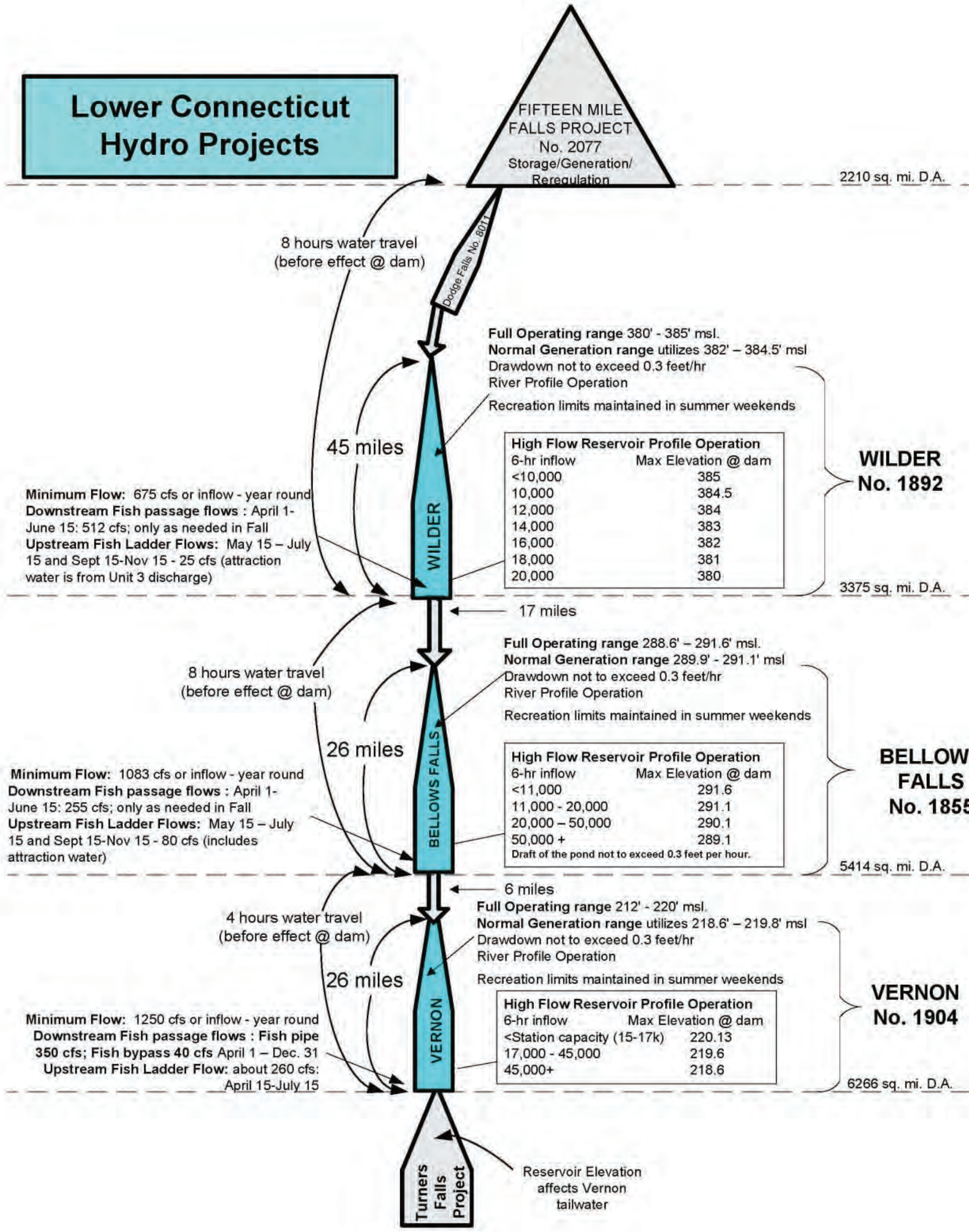
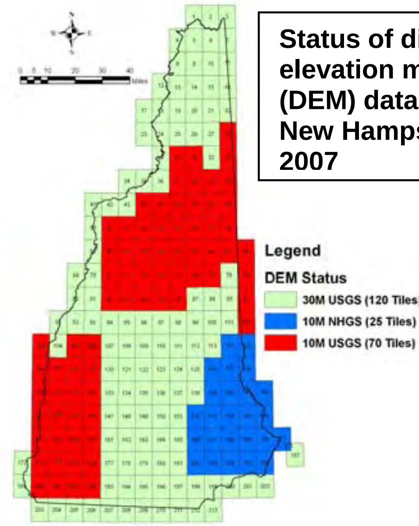


Figure 2.5-1. Connecticut River operations summary.

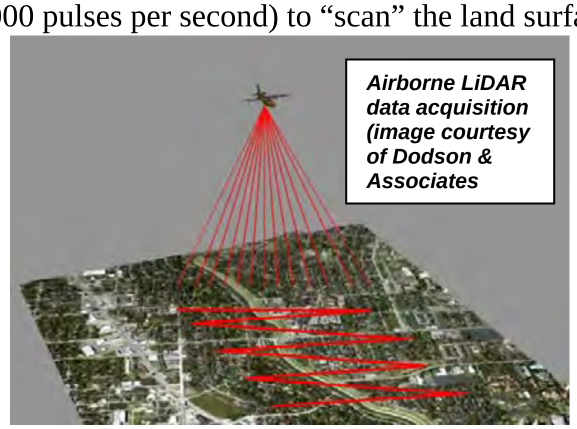
AN ENHANCED STATEWIDE ELEVATION DATASET FOR NEW HAMPSHIRE: THE CASE FOR LIDAR

The NH Geographic Information System (GIS) Strategic Plan identifies the need to develop statewide high-quality topographic data to replace the existing mixed resolution data for NH (statewide 30-meter and partial 10-meter digital elevation models) available as part of the US Geological Survey (USGS) National Elevation Dataset. The cost associated with a project of this scope together with the recognition that a variety of GIS users have the potential to benefit significantly from the availability of an enhanced topographic dataset, suggest that a number of funding partners should be engaged in any development effort. Perhaps the most critical use of these data has been highlighted by recent flooding events in the state. A recently published report by the National Academy of Sciences (*Elevation Data for Floodplain Mapping, 2007*) (http://www.nap.edu/catalog.php?record_id=11829 – Hidden) points out the deficiencies of available land surface elevation data to support modernization of floodplain maps under the National Flood Insurance Program administered by the Federal Emergency Management Agency (FEMA). The report states that "FEMA needs land surface elevation data that are about ten times more accurate than data currently available for most of the nation."

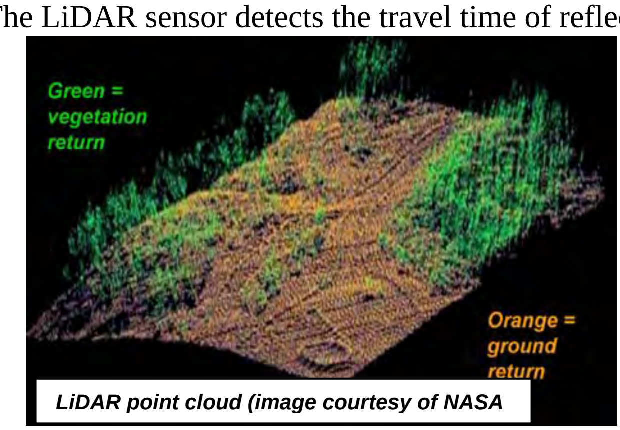
Status of digital elevation model (DEM) data in New Hampshire, 2007



Airborne LiDAR (Light Detection And Ranging) technology is recommended as the preferred method for acquiring data of sufficient accuracy and resolution. This method uses laser pulses (between 5,000 and 50,000 pulses per second) to "scan" the land surface. The LiDAR sensor detects the travel time of reflected



Airborne LiDAR data acquisition (image courtesy of Dodson & Associates



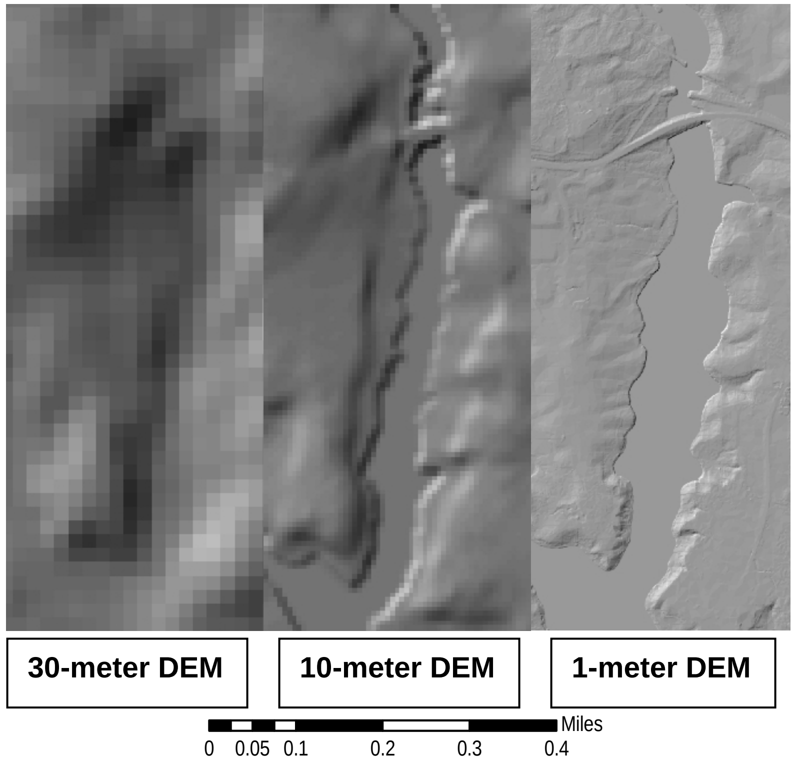
LiDAR point cloud (image courtesy of NASA

energy from each pulse, including a 'first return" for the first reflective surface in its path, but also potentially records multiple returns as the light beam penetrates to different "soft" surfaces at lower levels within a vegetated area. Post-processing of the collected data is then performed to extract a bare earth terrain model, but also can be used to derive vegetation characteristics (such as forest canopy height and density) and/or to extract structural features within the built environment.

As the availability of LiDAR data has increased through statewide initiatives (i.e. North Carolina, New Jersey, Florida, Pennsylvania, New York) and more localized projects, the number and range of demonstrated uses and experimental applications has grown tremendously. A high-resolution bare-earth digital elevation model (DEM) supports the detailed classification of landforms. These data in turn serve as the framework for ecological and habitat assessments used to prioritize land conservation and restoration efforts, but also enable geologic hazards, such as potential landslides, to be mapped. Many of the uses are focused on activities related to the assessment and management of water resources, such as watershed delineation, floodplain mapping, stormwater management, water quantity and quality modeling within watersheds, land cover/ land use mapping, etc. Other potential applications exist in the areas of transportation, forestry, agriculture, and emergency management.

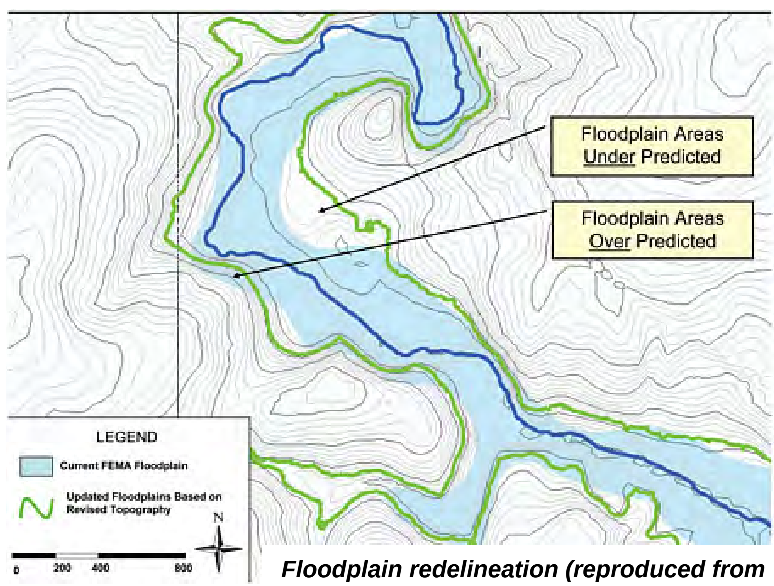
The NH GIS Strategic Plan also identifies a critical need for statewide high resolution orthoimagery, with repeat coverage at some specified time interval in order to enable changes in land use/land cover to be monitored. An accurate digital terrain model (DTM) is required to orthorectify the original aerial photographs so that the resulting imagery can support detailed spatial analyses. Although this process can be performed with elevation data that have been derived photogrammetrically, a DTM created from LiDAR has the potential to support additional applications that benefit from higher resolution elevation data. Therefore, a certain economy could be realized by investing in LiDAR data as an integral part of any program to acquire high resolution orthoimagery. Because of this potential to achieve mutual benefits, advocates for developing one dataset might be enlisted to promote development of the other dataset.

Comparison of terrain models for Fresh Creek, Strafford County, NH: NED 30-meter and 10-meter DEMs versus 1-meter LiDAR



While FEMA clearly is an important stakeholder given the utility of LiDAR for updating and refining flood hazard maps, other significant interests could be served through a cost-sharing data development initiative. The "Elevation for the Nation" (http://lidar.cr.usgs.gov/downloadfile.php?file=Harding_Elev4Nation_2-15-07_small.pdf) initiative recently unveiled by the USGS is evidence of the overall importance and broad applicability of this dataset. This announcement identifies USGS as a prime advocate for a statewide LiDAR project, if not as a potential funding partner. Funding should also be solicited from other entities that would benefit directly from such a project, assuming that data acquisition and processing could be specified and coordinated in order to meet their needs.

The following summary of organizations and some of their related business needs is intended as a starting point for building the necessary partnerships:



Floodplain redelineation (reproduced from the National Academies Press, 2007)

- U.S. Environmental Protection Agency – enhanced terrain data should improve the accuracy of watershed models used to assess total maximum daily loads by better defining flow pathways across the landscape.

- U.S. Forest Service – multiple return data from LiDAR surveys can be used to determine tree canopy height and stand density (or total biomass) and also support fire fuel mapping; bare earth digital terrain models can assist with the layout of road networks for timber harvests.

- Natural Resources Conservation Service – detailed topographic data are useful for high intensity soil surveys and for designing erosion control structures or defining best management practices for minimizing erosion.

- National Oceanic and Atmospheric Administration – storm surge modeling to mitigate flood inundation and coastal erosion hazards; shoreline delineation and monitoring of sea-level rise.

- NH Department of Transportation – design of new roads and stormwater drainage systems; improved estimation of volumes of material involved in cut and fill operations.

- Various state agencies and private non-profit organizations whose mission involves environmental conservation and resource management.

- Private sector telecommunications companies – siting of cell towers to minimize gaps in coverage due to interferences from terrain and trees depend on highly accurate terrain models and forest land cover assessments.

- Private sector wind energy producers – siting of wind turbines to maximize exposure.

CONNECTICUT RIVER WATERSHED COUNCIL
The River Connects Us
Upper Valley: P.O. Box 206, Saxtons River, VT 05154

March 1, 2013

Honorable Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

Re: Wilder Project No. 1892
Bellows Falls Project No. 1855
Vernon Project No. 1904
Comments on the Pre-Application Document, Scoping Document 1, and Study Requests

Dear Secretary Bose,

The Connecticut River Watershed Council, Inc. (CRWC) is a nonprofit citizen group that was established in 1952 to advocate for the protection, restoration, and sustainable use of the Connecticut River and its four-state watershed. We love to celebrate the River and its tributaries. We are proud that the Connecticut River was designated one of 13 American Heritage Rivers during the Clinton Administration and became the country's first National Blueway in 2012. The Connecticut River is a tremendous recreational resource, and as such, we have published the Connecticut River Boating Guide, which describes each reach of the 410-mile long river and all access and camping points. Paddlers and motor boaters alike find this book useful for planning outings and lengthy trips. We also organize an annual Source to Sea Cleanup that involves thousands of volunteers each year helping to keep our rivers free of litter and trash dumping.

The interests and goals represented by CRWC include, but are not limited to, improving water quality; enhancing habitat for fish and other aquatic biota; safeguarding and improving wildlife habitat; protecting threatened and endangered species; protecting wetlands; preserving undeveloped shore lands; enhancing public recreation and promoting recreational safety; protecting aesthetic values; protecting archeological, cultural, and historical resources; fostering sustainable economic development, energy production, and preserving the local tax base along the Connecticut River and its tributaries.

The Council's members use and are concerned about the area of the Connecticut River affected by the presence and operation of the Wilder, Bellows Falls, and Vernon Dams, owned and operated by TransCanada. CRWC is committed to working with FERC and other stakeholders to implement an Integrated Licensing Process for these projects that will positively affect the Connecticut River and its resources for present and future generations. CRWC has intervened in relicensing proceedings and license amendments at the Holyoke Dam (FERC No. 2004), Canaan Dam (No. 7528), Fifteen Mile Falls (No. 2077), Vernon (No. 1904), and Northfield Mountain Pumped Storage projects on the Connecticut River. CRWC was an Intervenor in TransCanada's purchase of hydroelectric projects on the Connecticut and Deerfield Rivers in 2005, and is an active participant in the National Pollutant Discharge Elimination System (NPDES) permit for the Entergy Vermont Yankee nuclear power plant.

We appreciate the opportunity to submit our comments on the Pre-application Documents (PADs), Scoping Document 1, and we are also submitting multiple study requests. Our comments on the PADs and Scoping Document 1 are organized by the sections of each respective document. The full text of our study requests are located in an appendix to this letter.

CRWC comments on the Pre-Application Documents (PADs)

Wilder Dam PAD

2.3.3 Fish Passage Facilities. There is nothing in the PAD that addresses the passage of American eels. This is far up river but eels have been found in this reach and should be accommodated with upstream and downstream passage. Effectiveness studies should be done on the passage of American eels.

Downstream Fish Passage – Effectiveness Evaluations. Again, there has been no effectiveness study relative to the passage of American eels. Such a study should be conducted before formal application for the facility is filed or required as a license article.

2.3.5 Project Boundary and Land. TransCanada should continue operating all of the recreation facilities currently located within the project lands. TransCanada should expand recreation opportunities beyond those in place now to offer hiking, biking, bird watching and other land based opportunities. If land is not available in terms of current ownership, TransCanada should be required to secure land fee simple or through easement to expand recreational opportunities beyond those located at the hydro facility.

2.4 Project Reservoir. Operation affecting reservoir level should be restricted to the historic usage level as opposed to the permitted levels in the existing license especially during spring and fall spawning season for fish to insure that spawning redds on the edge of the reservoir are not dewatered.

3.2 General Description of the Watershed. There is no description of the river and the falls under the dam in this section. There should be a full description of the river without the dam in place as well as a description of the falls and the resource lost in the construction of the dam.

3.4.6 Project Effects. CRWC disagrees with the conclusion in the PAD that project operations have no or minimal affect on shoreland erosion. A full river reconnaissance should be conducted before formal application or become a license condition in the new license that a full study of the effects of reservoir operations have on the erosion activity on the banks.

3.5.3 Water Use. CRWC does not agree that there should be no change in operations of the facility as that operation affects the reservoir levels. Operation affecting reservoir level should be restricted to the historic usage level as opposed to the permitted levels in the existing license especially during spring and fall spawning season for fish to insure that spawning redds on the edge of the reservoir are not dewatered.

3.6.2 Summary of Existing Fishery Studies. Since there are no targeted studies for this reach of river for resident or diadromous species, such a study should be required before formal application or required as an article in the new license.

Bellows Falls Dam PAD

2.3.6 Ancillary Buildings and Recreation Facilities. This section claims a portage trial as one of the recreation amenities around the Bellows Falls facility. Those using the 'trail' would not be so generous as to describe it as a trail in that it takes you 1½ miles from the takeout to the launch along a major state highway, much of it a high speed highway without a sidewalk or other protection area for foot traffic.

2.3.6 Project Boundary and Land. CRWC calls on TransCanada to increase access to the river, not only for boating and fishing, but also for other outdoor recreation including hiking, biking and bird watching. Those activities require trails and access points. As part of building that network, TransCanada should formally provide easement protections to be transferred to an appropriate third party for long term stewardship. The land holdings are modest for these projects so where necessary, TransCanada should be buying lands that would insure access and provide hiking/biking/birding trails along the river.

2.4 Project Reservoir. The operating range in terms of reservoir drawdown should be limited to the usual operating range set out in the PAD, not the licensed range under the existing permit. This will give added protection to fish redds at the edges of the reservoir during spawning times.

2.5.2 Normal Operations. The bypass reach at this facility is dewatered most of the time. The dry river bed is an affront to look at and it is a dead zone in the river. CRWC is not in a knowledgeable position to suggest a specific flow level for the bypass reach, but we include a study request to determine the best flow to restore the life in the river balanced with cost of running that water in that reach. The coffer dam at the down river end of the reach should be removed so fish can easily return into the reach once it has a minimum flow reestablished.

3.3 River Basin Description. The PAD includes a basic river basin description, but there is no specific information about the condition of the river prior to 1928 when the dam began operation. There is a lot of logging history in that particular reach of the main river and there are legends about the river itself and the steepness of the pitch over the falls. It is known that it was so steep that shad could not negotiate getting above the falls. There should be an additional section in the revised PAD that talks about the geological history of the river in the Bellows Falls reach and the falls that were submerged due to the building of the canal.

3.4.5 Reservoir Shoreline and Streambanks. The discussion in this section is held together by reference to a recent report done by Kleinschmidt in 2012. The report inventories the number and type of erosions site in the three impoundments. It then, based on discussions about impacts on the land when all of their work seems to have been done from a boat, reaches a startling conclusion with little discussion about the numerous forces that cause erosion in a reservoir setting and state "and therefore Project operations would not likely be a significant contributor to erosion in the impoundments as compared to naturally occurring high river flows; bank-full conditions." CRWC and many other organizations and people disagree with that blanket statement. A detailed study of all erosion forces acting on the river including project operations should be done prior to the submittal of the formal license application (see attached study request).

Table 3.5-14. This table lists towns within the Connecticut River watershed, above the Project with wastewater treatment facilities. We are confused about a reference to a non-existent town, Putney, NH. Putney, VT, which does exist, is down river of the Bellows Falls facility.

3.6.1 Summary of Existing Resources. **Fish Passage:** There is no mention of passing American eels in this section of the PAD dealing with fish resources. CRWC agrees with both the US Fish and Wildlife Service and the NH Fish and Game Department that a study of available habitat above this dam and a system for passing American eel above this dam should both done prior to formal application and whatever steps are necessary to pass American eel should become an article on the new license. See attached study request.

Vernon Dam PAD

2.3.3 Fish Passage Facilities. There have been concerns voices by the fish resource agencies that the attraction water is not as effective at Vernon since the license was amended to change out several turbines in 2008. There should be a study to see if the facility is operating as effectively as possible. There is no mention of passing American eels in this section of the PAD dealing with fish resources. CRWC agrees with both the US Fish and Wildlife Service and the NH Fish and Game Department that a study of available habitat above this dam and a system for passing American eel above this dam should both done prior to formal application and whatever steps are necessary to pass American eel should become an article on the new license. See attached study requests.

2.3.5 Project Boundary and Land. CRWC calls on TransCanada to increase access to the river, not only for boating and fishing but also for other outdoor recreation including hiking, biking and bird watching. Those activities require trails and access points. As part of building that network, TransCanada should formally provide easement protections on any lands held fee simple to be transferred to an appropriate third party for long term stewardship. The land holdings are modest for these projects so where necessary TransCanada should be buying lands that would insure access and provide hiking/biking/birding trails along the river.

2.4 Project Reservoir. The operating range in terms of reservoir drawdown should be limited to the usual operating range set out in the PAD, not the licensed range under the existing permit. This will give added protection to fish redds at the shores of the reservoir during spawning times.

2.5.1 Basin Information. There is nothing in the PAD that describes the pre dam river setting. What falls were there and what natural features of the river were lost with the construction of the dam?

3.4.6 Project Effects. The discussion in this section is held together by reference to a recent report done in 2012. The report inventories the number and type of erosions site in the three impoundments. The report then, based on observations about impacts on the land when all of their work seems to have been done from a boat, reaches a startling conclusion with little discussion about the other numerous forces that cause erosion in a reservoir setting and state “and therefore Project operations would not likely be a significant contributor to erosion in the impoundments as compared to naturally occurring high river flows; bank-full conditions.” CRWC and many other organizations and individuals disagree with that blanket statement. A detailed study of all erosion forces acting on the river including project operations should be done prior to the submittal of the formal license application.

3.6.1 Summary of Existing Resources. **Fish Passage** There is no mention of passing American eels in this section of the PAD dealing with fish resources. CRWC agrees with both the US Fish and Wildlife Service and the NH Fish and Game Department that a study of available habitat above this dam and a system for passing American eel above this dam should both done prior to formal application and whatever steps are necessary to pass American eel should become an article on the new license.

3.6.6 Aquatic Habitat. The Vernon dam is in a uniquely difficult location when it comes to aquatic habitat. The thermal discharge from the Entergy Vermont Yankee nuclear power plant occurs .4 miles upriver from the dam. The Entergy discharge comes into the river from the Vermont shore and does not fully mix before it is sweeps down the fish ladder and through the smolt passage pipe. The temperature of the water can be as high as 105^0 F at a maximum permitted flow of 543 million gallons per day (MGD). This amount of heated water can alter aquatic habitat for all species as well as providing a barrier to catadromous fish on their migrations either up or down river.

CRWC Comments on Scoping Document 1

3.1 No action alternative

The science about rivers and about the species that depend on rivers has come a long way since FERC licensed these dams in the 1970s. Hence CRWC does not support the no action alternative and puts forth information requests and study request in this document to augment our understanding of the impact of these dams and how changing their operation can mitigate the negative effects on the river.

3.4.1 Proposed facilities and operations

Trans Canada is not proposing to change facilities or operations. CRWC feels that limiting drawdowns as recommended below will improve the health of the river and those drawdown changes should become a condition in each of the new licenses.

3.4.2.1 Wilder Project proposed environmental measures

Water Resources

- The limit on reservoir drawdown to elevation 380 feet (a 5-foot drawdown) should be reduced to their current use of a 2.5-foot drawdown for peaking operation. This will benefit fish spawning in the shallow areas at the edges of the reservoir.

- The current requirement to maintain a continuous minimum flow of 675 cfs should not be changed until there is information about the effects of the increased wetted area at the suggested voluntary flow and whether that small increase is appropriate and improves the health of the river. The voluntary flow increase stated in the Scoping Document 1 may not be large enough or too large to protect the mist plant colony immediately downstream of the dam.

- Current license requirements provide for upstream fish passage for migrating Atlantic salmon and American shad. Since the salmon stocking program has ended and given that Wilder is well beyond the historic range of the American shad, CRWC feels that the facility should be operated to benefit resident species of fish and the American eel. Neither benefit from the current seasonal schedule of operations and the flows associated with an operating fish ladder designed to move salmon.

- TransCanada should continue to provide downstream fish passage, not necessarily just for outmigrating diadromous fish but for all fish including resident species.

Recreation Resources

- TransCanada should not just operate and maintain a public viewing area with an observation deck and underwater window at upstream fish passage facility at Wilder but should develop education programs aimed at the public including outreach, scheduled classes or seminars about the river and its habitat and encourage people to use the viewing area.

- TransCanada should continue to operate and maintain all recreation facilities currently in place. They should also improve the portage trail around the dam by reducing the stairway risers for the steps at eh stairway. There should be a variable floating launch platform for canoes and kayaks.

- CRWC calls on TransCanada to increase access to the river, not only for boating and fishing, but also for other outdoor recreation including hiking, biking and bird watching. Those activities require trails and access points.

<u>3.4.2.2 Bellows Falls Project Proposed Environmental Measures</u>

Water Resources

- CRWC feels that the 3-foot draw down approved in their current license should be reduced to their current use of a 1.8-foot draw down for peaking operation.

- Instream minimum flow should be evaluated prior to any flow requirement is established in the license.

Aquatic Resources

- TransCanada should maintain and operate an upstream vertical slotted weir fish ladder at the powerhouse. The fish ladder function should change from addressing anadromous fish such as salmon and shad and instead be redesigned for the movement of diadromous fish such as the American eel and resident species.

- The bypass reach at the facility should be re-watered at some level once it is determined what the best-wetted area would be for fish and other aquatic organisms. The concrete barrier dam at the downstream end of the bypass reach intended to stop migrating fish entering the bypass reach should be removed.

- TransCanada should continue to provide downstream passage via the forebay sluiceway/skimmer gate.

Recreation Resources

- TransCanada should not just operate and maintain a public viewing area with an observation deck and underwater window at upstream fish passage facility at Bellows Falls but should develop education programs aimed at the public including outreach, scheduled classes or seminars about the river and its habitat and encourage people to use the viewing area.

- TransCanada should continue to operate all recreation facilities. They should improve the route, distance, safety of the portage around the dam.

- CRWC calls on TransCanada to increase access to the river, not only for boating and fishing, but also for other outdoor recreation including hiking, biking and bird watching. Those activities require trails and access points.

<u>3.4.2.3 Vernon Project</u>

Water Resources

- TransCanada should evaluate the effects of the current minimum flow to determine if other flow levels would add to the health of the river and reduce erosion.

- CRWC feels that the 8-foot draw down approved for this facility should be reduced to their historic use of a 2-foot draw down for peaking operation.

- We recently received notification that FirstLight filed a Hydraulic Modeling Assessment of the Turners Falls Impoundment, Turners Falls Hydroelectric Project (No. 1889) and Northfield Mountain Pumped Storage Project (No. 2485) with FERC. FirstLight states in the report that "[t]he findings contained herein demonstrate that the TF Impoundment does not backwater to the base of the Vernon Dam and that the upstream influence of the TF Project is located approximately 9,000 feet downstream of Vernon Dam, or just below Stebbins Island. The findings also show that hydraulic control of the river shifts from the TF Dam to the Gorge at a flow of approximately 30,000 cfs. Accordingly, FL intends to propose a geographic scope for its relicensing studies limited to the zone of impact of the TF Project. In addition FL will propose modifying both the width and upstream geographic extent of the Project Boundary as part of its relicensing proposal." Since the report was made available on February 22, 2013, we did not have adequate time to review the report. However, any discussion about changing the Turners Falls project boundary should also include consideration about whether the section of the river just downstream of Vernon should now be included in the Vernon Project boundary.

Aquatic Resources

- TransCanada should maintain and operate an upstream fish passage facility designed to pass migrating American shad upstream past the dam. The timing of operations should include considerations for resident species and the American eel.

- TransCanada should continue to provide downstream fish passage.

Recreation Resources

- TransCanada should not just operate and maintain a public viewing area with an observation deck and underwater window at upstream fish passage facility at Vernon but should develop education programs aimed at the public including outreach, scheduled classes or seminars about the river and its habitat and encourage people to use the viewing area.

- The public viewing areas for fish passage and signage is shabby and should be updated. See photo below.

Figure 1. Fishway viewing entrance and sign. With the sign barely readable and the "keep off" signs on the fence, few visitors would realize that the fish viewing area is down the steps.

- TransCanada should continue to operate and maintain all current recreation facilities including the Vernon Neck Demonstration Forest Area.

- Portage around the dam is difficult at best and the pathway should be improved for ease and safety of those using it.

- CRWC calls on TransCanada to increase access to the river, not only for boating and fishing, but also for other outdoor recreation including hiking, biking and bird watching. Those activities require trails and access points.

3.6 Alternatives considered but eliminated from detailed study. Subsection 3.6.3 states that Project decommissioning has been eliminated from further consideration. CRWC believes the decommissioning alternative should be considered, with no particular facility targeted, but an overall look at the cumulative effects and all options considered. Could there be one dam removed, and other modifications made to existing hydropower facilities, to make for a win-win situation for the river and for power generation? The TNC/USACE/UMASS flow model could be employed to complete such an alternatives analysis.

4.1.2 Geographic Scope

The five Connecticut River Projects are located contiguously on the main stem Connecticut River flooding some 140 miles of the riverbed. Since the damming of the river occurred at different times there was no coordinated analysis of the overall changes to the habitat of the river quantifying the changing of riverine habitat to a reservoir/lacustrine habitat. There was no information in the PADs that indicated what the river habitat was before the dams were constructed by the then owner. TransCanada should provide a historic review of documents that would show the state of the river before the dams, the state of lands before they were inundated by the reservoirs formed by the dams, and an inventory of wetlands before and after the construction of the dams. This would answer the question of what habitat and conditions were given up when the river became a long lake.

4.1 Cumulative effects.

4.1.1: Resources.

- At the scoping meetings, enough people brought up the issue of multi-day paddle trips and need for more and better access points and campsites and improved portage around dams, that the presence of four dams can be considered to have cumulative impacts on recreational uses.

- Floodplain communities have mostly been lost as a result of flood control dams and hydropower dams. To the extent possible, the cumulative impact of hydropower plants on these resources should be examined.

- Sediment movement, or lack thereof, is a cumulative impact of the dams.

4.3.2 Geographic Scope. Flows at Wilder on downstream to Turners Falls are impacted by the operation of Fifteen Mile Falls. Flows from Fifteen Mile Falls down to Holyoke Dam should be considered in the geographic scope of the area that is cumulatively affected. Contributions from Vermont Yankee should be considered within the cumulative effects analysis.

4.1.3 Temporal Scope: We are presently in a period of time during which the energy generation industry is changing dramatically as we attempt to change patterns to ward off severe climate change. We have little understanding of how this will all play out in the coming decades, and there is much disagreement about how climate change will affect our civilization. We therefore recommend that the new licenses be the shortest possible length, or 30 years, as allowed by law. License conditions could also be incorporated that allow for re-evaluation of flows, habitat, and changed hydrology as a result of climate change.

4.2.1 Geology and Soil Resources

We agree that quantifying the effects of the reservoir drawdowns should be looked at relative to the reservoir effects on shoreland erosion.

4.2.2 Water Resources

We agree that the waters of the river are affected by the slow flows and exposure to the sun during low flow and warm weather periods and that is a concern. We are especially concerned about temperature modifications adding together below the site of the Entergy VY thermal discharge. Not only might they together lower DO levels, but also the temperature increase could trigger shad spawning before the fish have migrated to limit of their historic range at Bellows Falls.

4.2.3 Aquatic Resources

There was no information presented in the PADs about entrainment and impingement of all manner of aquatic species at each of the dams. There should be some quantifiable data developed to look at the loss of young of the year fish and other smaller organisms being drawn into and through the turbines. The study should quantify any loss of organisms and a limit of loss established.

4.2.7 Land Use

TransCanada should open their lands and if necessary purchase lands to insure that shoreland erosion is not caused by farming practices that strip the land of its riparian zone of native plants to protect against erosion.

4.2.8 Aesthetic Resources

Although TransCanada does not identify any outstanding issues with aesthetics, there clearly is one at the Bellows Falls bypass reach. A completely dry and desolate reach of river is an eyesore.

Section 6.0 Request for information and studies

Multiple study requests have been drafted by federal and state resource agencies, researchers, and nongovernment organizations for the Turners Falls and Northfield Mountain Pumped Storage projects. The number of study requests indicates the possible impacts the projects have on the Connecticut River and how little we know about these impacts now and in the future. We support these group-generated study requests, adopt them as our own with some modifications, and encourage FERC to require the applicant to undertake these studies. CRWC staff provided comments during the generation and drafting of several of these study requests.

Geology and Soil Resources

CRWC is concerned about the effects the three project operations has on streambank stability and request that the following studies be conducted to address our concerns on these issues (the full text of the study requests are found in the Appendix).

Study requests

- Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations for Wilder Dam (Study Request #1)
- Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations for Bellows Falls Dam (#2)
- Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations for Vernon Dam (#3)

<u>Water Resources</u>

Additional information requested

- Please provide a description of the pre dam river setting at each of the three impoundments. Describe the falls that had been in place and the natural features of the river were lost with the construction of the dam.

Study requests

- Climate Change as it Relates to Continued Operation of the Vernon, Bellows Falls, Wilder, Northfield Mountain Pumped Storage, and Turners Falls Projects (#4)
- Continuous water temperature monitoring (15 minute intervals) at various locations within the Wilder Hydroelectric Project Impoundment and Tailrace, and Connecticut River downstream of the Wilder Dam (#5)
- Continuous water temperature monitoring (15 minute intervals) at various locations within the Bellows Falls Hydroelectric Project Impoundment and Tailrace, and Connecticut River downstream of the Bellows Falls Dam (#6)
- Continuous water temperature monitoring (15 minute intervals) at various locations within the Vernon Hydroelectric Project Impoundment and Tailrace, and Connecticut River downstream of the Vernon Dam (#7)
- Water quality monitoring within the project impoundment and tailrace, Wilder Hydroelectric Project (#8)
- Water quality monitoring within the project impoundment and tailrace, Bellows Falls Hydroelectric Project (#9)
- Water quality monitoring within the project impoundment and tailrace, Vernon Hydroelectric Project (#10)
- Model River Flows and Water Levels Upstream and Downstream from the Wilder, Bellows Falls, and Vernon Stations and Integration of Project Modeling with Downstream Project Operations (#11)
- Bellows Falls Bypass Flow (#12)

<u>Aquatic Resources</u>

Additional information available

The USEPA has published a “Connecticut River Fish Tissue Contaminant Study 2000” available online at http://www.epa.gov/region1/lab/reportsdocuments/ctriverftr2000/index.html. This study shows that fish tissue in river segments affected by fluctuations from Fifteen Mile Falls on down to the Turners Falls Dam have higher mercury concentrations than downstream reaches, which are either not impounded or do not fluctuate to the degree of upstream reaches. High fluctuation of lake reservoirs have been associated with higher rates of mercury methylation, and therefore higher levels of mercury in fish tissue (see for example http://nsrcforest.org/project/understanding-how-lake-water-and-nutrient-levels-affect-mercury-levels-aquatic-organisms).

S*tudy requests*

- Channel Morphology and Benthic Habitat Impacts at the Vernon, Bellows Falls and Wilder Projects (#13)
- In-stream Flow Habitat Assessment Downstream of Wilder, Bellows Falls, and Vernon Dams (#14)
- Determine the Fish Assemblage in Vernon, Bellows Falls and Wilder Project-Affected Areas (#15)
- Impacts of Water Level Fluctuations on Aquatic Vegetation, Including Invasive Species, in the Vernon, Bellows Falls and Wilder Project Impoundments and Riverine Reaches (#16)
- Impacts of the Vernon, Bellows Falls and Wilder Project Impoundment Water Fluctuations on Resident Fish Spawning (#17)
- Impacts of Water Fluctuations Downstream of the Vernon, Bellows Falls and Wilder Projects on Resident Fish Spawning (#18)
- Impacts of the Vernon, Bellows Falls and Wilder Project Operations on Tributary and Backwater Area Access and Habitats (#19)
- Determine Upstream Passage Needs for Riverine Fish Species in the Bellows Falls, Wilder and Vernon Fishways (#20)
- Shad Population Model for the Connecticut River (#21)
- Telemetry Study of Upstream and Downstream Migrating Adult American Shad to Assess Passage Routes, Effectiveness, Delays, and Survival (#22)
- Impact of Project Operations on Shad Spawning, Spawning Habitat, and Egg Deposition in the Project Areas of the Turners Falls, Northfield Mountain Pumped Storage and Vernon Project Areas and downstream from Bellows Falls Dam (#23)
- Impact of Vernon Project Operations on Downstream Migration of Juvenile American Shad (#24)
- American Eel Survey Upstream of the Vernon, Bellows Falls, and Wilder dams (#25)
- Evaluation of Timing of Downstream Migratory Movements of American Eels on the Mainstem Connecticut River (#26)
- Upstream American Eel Passage Assessment at Vernon, Bellows Falls and Wilder Projects (#27)
- Downstream American Eel Passage Assessment at Vernon, Bellows Falls, and Wilder (#28)
- Assessment of Adult Sea Lamprey (*Petromyzon marinus*) Spawning within the Wilder, Bellows Falls, and Vernon Project Areas (#29)
- Bellows Falls Bypass Flow (#12)

Terrestrial Resources

Study requests

- Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations for Wilder Dam (Study Request #1)
- Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations for Bellows Falls Dam (#2)
- Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations for Vernon Dam (#3)

Threatened and Endangered Species

Study requests

- Effects of the Wilder and Bellows Falls Projects on the Dwarf Wedgemussel (*Alasmidonta heterodon*) (#30)
- Project Effects on Populations of Tessellated Darter, *Etheostoma olmstedi* (#31)

Land Use

- Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations for Wilder Dam (#1)
- Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations for Bellows Falls Dam (#2)
- Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations for Vernon Dam (#3)

Aesthetic Resources

Study requests

- Bellows Falls Bypass Flow (#12)

Socioeconomic Resources

Study requests

- Climate Change as it Relates to Continued Operation of the Vernon, Bellows Falls, Wilder, Northfield Mountain Pumped Storage, and Turners Falls Projects (#5)

Section 7.0 EIS Preparation Schedule

CRWC believes that the magnitude of river alteration caused by these five projects and the complexity of issues involved fully warrants an Environmental Impact Statement (EIS) under NEPA, as proposed by FERC.

We appreciate the opportunity to provide comments on the PAD, Scoping Document 1, and the study requests. We look forward to our active participation in the relicensing of the Connecticut River projects.

Sincerely,

David L. Deen
Upper Valley River Steward

Cc: John Ragonese, TransCanada
VT DEC
NH DES
VT DFW
NH DFG
USFWS
NOAA
Don Pugh, Trout Unlimited
Katie Kennedy, The Nature Conservancy
Windham Regional Commission
Connecticut River Joint Commissions

Appendix
CRWC Study Requests

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Study Request 16. Impacts of Water Level Fluctuations on Aquatic Vegetation, Including Invasive Species, in the Vernon, Bellows Falls and Wilder Project Impoundments and Riverine Reaches

Study Request 17. Impacts of the Vernon, Bellows Falls and Wilder Project Impoundment Water Fluctuations on Resident Fish Spawning

Study Request 18. Impacts of Water Fluctuations Downstream of the Vernon, Bellows Falls and Wilder Projects on Resident Fish Spawning

Study Request 19. Impacts of the Vernon, Bellows Falls and Wilder Project Operations on Tributary and Backwater Area Access and Habitats

Study Request 20. Determine Upstream Passage Needs for Riverine Fish Species in the Bellows Falls, Wilder and Vernon Fishways

Study Request 21. Shad Population Model for the Connecticut River

Study Request 22. Telemetry Study of Upstream and Downstream Migrating Adult American Shad to Assess Passage Routes, Effectiveness, Delays, and Survival

Study Request 23. Impact of Project Operations on Shad Spawning, Spawning Habitat, and Egg Deposition in the Project Areas of the Turners Falls, Northfield Mountain Pumped Storage and Vernon Project Areas and downstream from Bellows Falls Dam

Study Request 24. Impact of Vernon Project Operations on Downstream Migration of Juvenile American Shad

Study Request 25. American Eel Survey Upstream of the Vernon, Bellows Falls, and Wilder dams

Study Request 26. Evaluation of Timing of Downstream Migratory Movements of American Eels on the Mainstem Connecticut River

Study Request 27. Upstream American Eel Passage Assessment at Vernon, Bellows Falls and Wilder Projects

Study Request 28. Downstream American Eel Passage Assessment at Vernon, Bellows Falls, and Wilder

Study Request 29. Assessment of Adult Sea Lamprey (Petromyzon marinus) Spawning within the Wilder, Bellows Falls, and Vernon Project Areas

Study Request 30. Effects of the Wilder and Bellows Falls Projects on the Dwarf Wedgemussel (Alasmidonta heterodon)

Study Request 31. Project Effects on Populations of Tessellated Darter, Etheostoma olmstedi

<u>CRWC Study Requests</u>

Study Request 1. Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations for Wilder Dam

Goals and Objectives

The goal of this study is to determine how project operations contribute to the shoreline erosion and riverbank failure within the impoundment and downstream of the Wilder Hydro Project.

The objectives of this study are to:

1. determine how water level fluctuations within the minimum and maximum operating range and discharges from peaking operations at the Wilder hydroelectric project contribute to shoreline erosion;
2. identify and determine the effects of shoreline bank erosion and riverbank failure on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.);
3. identify techniques that could be used to mitigate the effects of project operations or other mitigation techniques that could be developed to reduce on riverbank erosion within the impoundment and downstream of the tailrace.

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish, wildlife, plants, and their habitats are important public resources. There is a strong public interest in protecting, conserving, and enhancing these resources for public benefit, including wetlands, endangered species, and migratory species. Eroding shorelines and banks can degrade water quality, impairing aquatic life and habitat. This study will determine how project operations contribute to the shoreline erosion and riverbank failure within the impoundment and downstream of the Wilder Hydro Project, providing important information for assessing potential degradation of aquatic life and habitat from project operations.

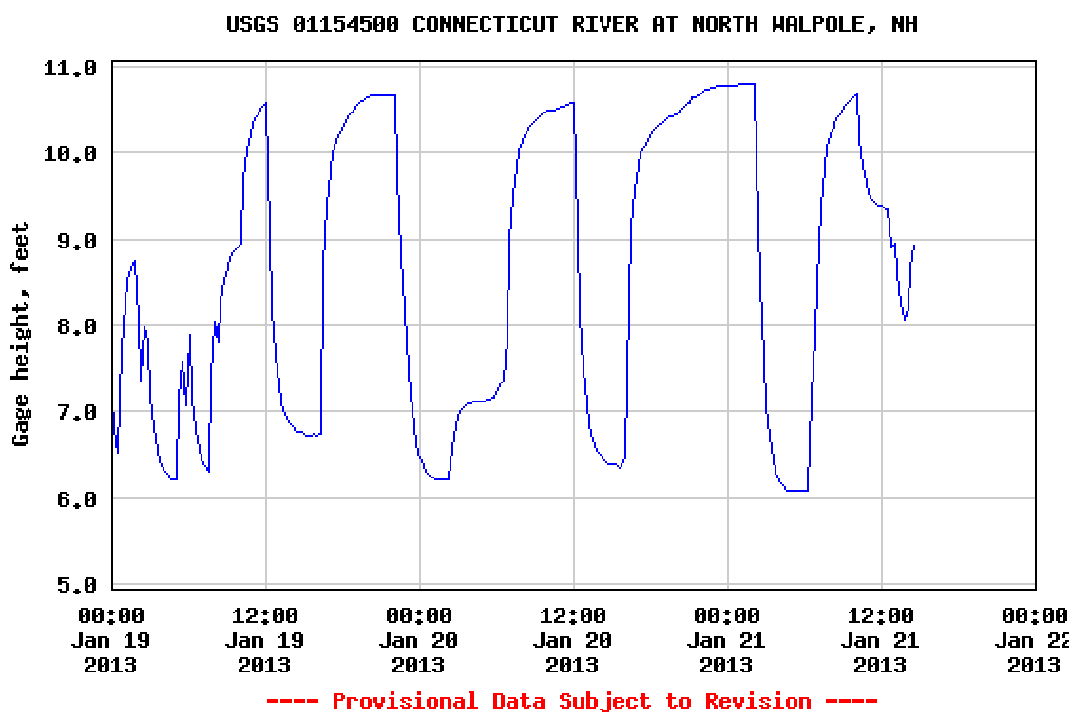
Existing Information

The PAD references several studies pertaining to shoreline erosion within the Connecticut River, including the study by US Army Corp of Engineers (Simion et al. 1979). This study evaluated the shoreline within the Wilder impoundment and identified water level fluctuation and periodic high flow events as causes of shoreline erosion. The PAD also discusses the erosion survey that TransCanada initiated in 2010 to inventory sites where erosion is occurring within the Wilder impoundment

(Kleinschmidt 2011). Bank slumping was identified as the major type of shoreline erosion within the project impoundment. Bank slumping can occur when fluvial erosional forces known as soil piping are acting on the toe of the bank slope, increasing the angle between the slope of the bank and water surface. The PAD did not address how project related operations contribute to shoreline erosion, could be changed to mitigate impacts on shoreline erosion, or discuss the impacts of shoreline erosion on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.).

Repetitive water level fluctuations and flow alterations caused by hydroelectric peaking operations are known to be a major contributor to shoreline erosion (Lawson 1985). Sediment from shoreline erosion and riverbank failure is one of the major contributors negatively affect water quality and habitat by increasing the turbidity and sedimentation, smothering aquatic habitat in United States. Vermont Surface Water Management Strategy identifies sediment from excessive channel erosion as a stressor on Vermont water and aquatic habitat. Additionally, Vermont lists this section of the Connecticut River on the Vermont Section 303(d) impaired water list due to flow alterations resulting from the destabilization and eroding of shoreline impairing aquatic life and habitat.

An example of the water level fluctuations that occur in Lower Connecticut River due to hydropower generation is shown below.



Project Nexus

Wilder Hydroelectric Project operations currently result in daily water level fluctuation in the impoundment by as much as 2.5 feet, which affects shoreline erosion in the impoundment by increasing the rate of soil piping. The project is currently permitted to water level fluctuation in the impoundment by 5 feet. Additionally the project "peaking" operation could contribute to bank erosion downstream of the dam by increasing the shear stress on the bank toe. Furthermore, river profile operations during high flow events minimize overland flow by drawing down impoundment prior to high flows containing high velocity flows to the river channel, possibly increasing shoreline erosion rate within the impoundment. TransCanada is not proposing any changes to project operations.

Proposed Methodology

We recommend TransCanada complete a study similar to the study completed by Kleinschmidt (2011). The study should be designed to build on erosion survey that was previously completed by determining the process causing erosion at a site, the extent erosion is negatively affecting other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.), and determining how erosion could be stabilized or mitigated by changing project operations. This study can be completed performing the following tasks.

Task 1: Determine erosion and riverbank failure process at identified sites

Shoreline erosion areas and riverbank failure sites were identified during the Kleinschmidt (2011) survey. Erosion sites that were identified during the previous survey should be revisited when the water level in the impoundment is at its lowest elevation, to collect information on erosion forces acting on the site, document if any additional erosion has occurred, and identified new sites of erosion within the impoundment. Erosion processes will be determined by field observations and applying site appropriate geology, geomorphic and hydrological principles. For each erosion site, the following erosion process element will be identified by determining soil type and subsoil characteristics (i.e. depth to bedrock, texture, rock content, signs of soil piping), reservoir water levels at the time of observation, water level fluctuation, climatic conditions, ground water seepage, wind-driven waves, boat waves, and recreation. Additional site characteristic to identify and record in the erosion survey will include but not be limited to an estimate of the length and average height of the erosional area, slope of the site, dominant vegetation cover types present, associated vegetation cover types present, an ocular estimate of total plant cover and total cover by plant class (tree, shrub, herbaceous) in surrounding undisturbed areas. **Riparian land use and presence/absence/size of vegetated buffer should be documented as well**. Data from each shoreline erosion site will be recorded on a field form and entered into a database. In addition, a photograph or photographs will be taken of each site. Completion of this evaluation will allow for a determination as to whether the erosion is Project related, and if so, how Project operations may be impacting the site.

Task 2: Determining the effects of erosion on other resources

The effects of shoreline erosion and riverbank failure on other resources should be determined. This will required coordination between studies to determine the effects of erosion on riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, and recreation. Erosion sites identified as having an impact on resources will be assess to determine if project operations are causing erosion and a mitigation plan to protect the resource of interest should be developed.

Task 3: Development of a Shoreline Management Plan

The information that is collected during the study should be used to develop a Shoreline Management Plan for the impoundment. Sites that are determined to impact important resources should be further evaluated to determine if there is a feasible way to reduce or stabilize the area. This feasibility analysis will be based on field observations and knowledge of current erosion control and slope failure stabilization methods that may be suitable for the site. The analysis will provide a preliminary list of potential control measures necessary to reduce erosion at these sites. Detailed analyses for final design and construction of erosion and slope stabilization control measures will not be part of the study. As part of this process, the landowner should be identified for each of the erosion site and future mitigation and stabilization techniques should be presented.

The study area for the shoreline erosion study should extend from the upstream end of the impoundment above the Wilder Dam to the beginning of the impoundment below the Wilder Dam. Water level fluctuations caused by the Project may affect not only the impoundment but also the downstream river reaches below the dam.

Level of Effort and Cost

The cost and effort of this study will be moderate, but is important to document the potential impact project operations on shoreline erosion and riverbank failure, and to determine how this may impact other resources.

Literature Cited

Kleinschmidt (Kleinschmidt Associates, Inc.). 2011. Lower Connecticut River Shoreline Survey Report – 2010: Bellows Falls Project (FERC No. 1855), Wilder Project (FERC No. 1892), Vernon Project (FERC No. 1904). Draft Report March 2011. Prepared for TransCanada Hydro Northeast Inc.,Westborough, MA.

Lawson, D.E., 1985, Erosion of northern reservoir shores: An analysis and application of pertinent literature: US Army Corps of Engineers Cold Regions Research and Engineering Laboratory Monograph 85-1, 198 p.

Simons, D.B., Andrews, J.W., Li, R.M., and Alawady, M.A. 1979. Connecticut River Streambank Erosion Study Massachusetts, New Hampshire, and Vermont. Prepared for USACE, New England Division.

Study Request 2. Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations for Bellows Falls Dam

Goals and Objectives

The goal of this study is to determine how project operations contribute to the shoreline erosion and riverbank failure within the impoundment and downstream of the Bellows Falls Hydroelectric Project.

The objectives of this study are to:

1. determine how water level fluctuations within the minimum and maximum operating range and discharges from peaking operations at the Wilder hydroelectric project contribute to shoreline erosion;
2. identify and determine the effects of shoreline bank erosion and riverbank failure on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.);
3. identify techniques that could be used to mitigate the effects of project operations or other mitigation techniques that could be developed to reduce on riverbank erosion within the impoundment and downstream of the tailrace.

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

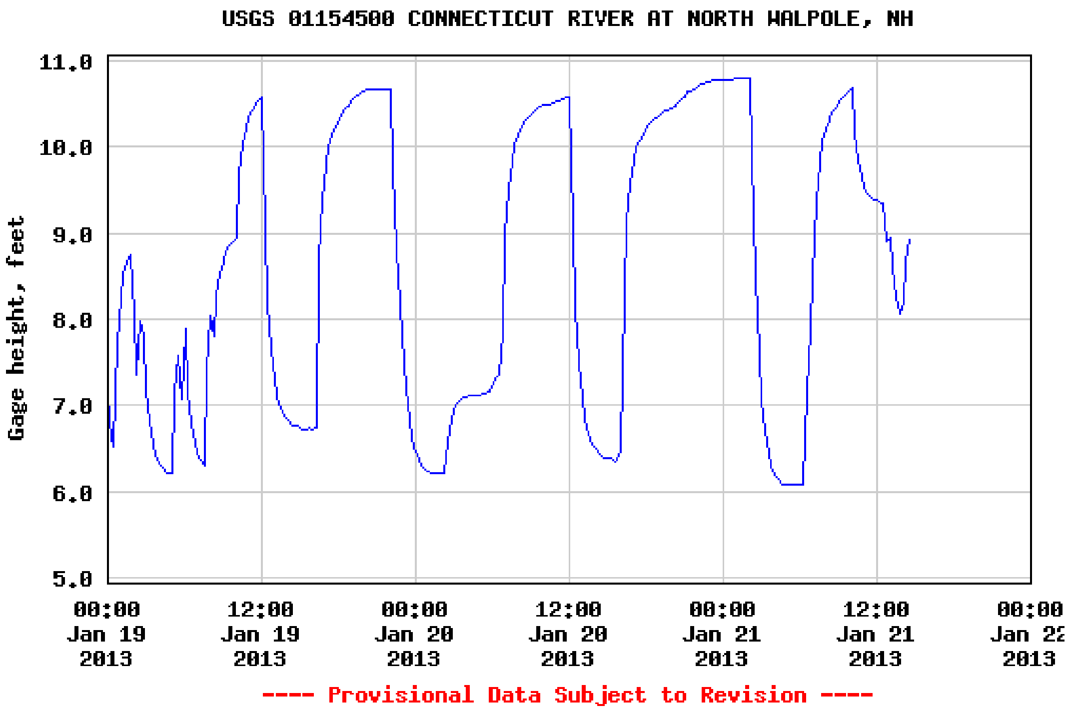
Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish, wildlife, plants, and their habitats are important public resources. There is a strong public interest in protecting, conserving, and enhancing these resources for public benefit, including wetlands, endangered species, and migratory species. Eroding shorelines and banks can degrade water quality, impairing aquatic life and habitat. This study will determine how project operations contribute to the shoreline erosion and riverbank failure within the impoundment and downstream of the Bellows Falls Hydroelectric Project, providing important information for assessing potential degradation of aquatic life and habitat from project operations.

Existing Information

The PAD references several studies pertaining to shoreline erosion within the Connecticut River, including the study by US Army Corp of Engineers (Simion et al. 1979). This study evaluated the shoreline within the Wilder impoundment and identified water level fluctuation and periodic high flow events as causes of shoreline erosion. The PAD also discusses the erosion survey that TransCanada initiated 2010 to inventory sites where erosion is occurring within the Bellows Falls impoundment (Kleinschmidt 2011). Bank slumping was identified as the major type of shoreline erosion within the project impoundment. Bank slumping can occur when fluvial erosional forces known as soil piping are acting on the toe of the bank slope, increasing the angle between the slope of the bank and water surface. The PAD did not address how project related operations contribute to shoreline erosion, could be changed to mitigate impacts on shoreline erosion, or discuss the impacts of shoreline erosion on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.).

Repetitive water level fluctuations and flow alterations caused by hydroelectric peaking operations are known to be a major contributor to shoreline erosion (Lawson 1985). Sediment from shoreline erosion and riverbank failure is one of the major contributors negatively affect water quality and habitat by increasing the turbidity and sedimentation, smothering aquatic habitat in United States. Vermont Surface Water Management Strategy identifies sediment from excessive channel erosion as a stressor on Vermont water and aquatic habitat. Additionally, Vermont lists this section of the Connecticut River on the Vermont Section 303(d) impaired water list due to flow alterations resulting from the destabilization and eroding of shoreline impairing aquatic life and habitat.

An example of the water level fluctuations that occur in Lower Connecticut River due to hydropower generation is shown below.



Project Nexus

Bellows Falls Hydroelectric Project operations currently result in daily water level fluctuation in the impoundment by approximately 2 feet, which affects shoreline erosion in the impoundment by increasing the rate of soil piping. The project is currently permitted to water level fluctuation in the impoundment by 3 feet. Additionally the project "peaking" operation could contribute to bank erosion downstream of the dam by increasing the shear stress on the bank toe. Furthermore, river profile operations during high flow events the project impoundment is operated to minimize overland flow by drawing down impoundment prior to high flows containing high velocity flows to the river channel, possibly increasing shoreline erosion rate within the impoundment. TransCanada is not proposing any changes to project operations.

Proposed Methodology

We recommend TransCanada complete a study similar to the study completed by Kleinschmidt (2011). The study should be designed to build on erosion survey that was previously completed by determining the process causing erosion at a site, the extent erosion is negatively affecting other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.), and determining how erosion could be stabilized or mitigated by changing project operations. This study can be completed performing the following tasks.

Task 1: Determine erosion and riverbank failure process at identified sites

Shoreline erosion areas and riverbank failure sites were identified during the Kleinschmidt (2011) survey. Erosion sites that were identified during the previous survey should be revisited when the water level in the impoundment is at its lowest elevation, to collect information on erosion forces acting on the site, document if any additional erosion has occurred, and identified new sites of erosion within the impoundment. Erosion processes will be determined by field observations and applying site appropriate geology, geomorphic and hydrological principles. For each erosion site, the following erosion process element will be identified by determining soil type and subsoil characteristics (i.e. depth to bedrock, texture, rock content, signs of soil piping), reservoir water levels at the time of observation, water level fluctuation, climatic conditions, ground water seepage, wind-driven waves, boat waves, and recreation. Additional site characteristic to identify and record in the erosion survey will include but not be limited to an estimate of the length and average height of the erosional area, slope of the site, dominant vegetation cover types present, associated vegetation cover types present, an ocular estimate of total plant cover and total cover by plant class (tree, shrub, herbaceous) in surrounding undisturbed areas. **Riparian land use and presence/absence/size of vegetated buffer should be documented as well**. Data from each shoreline erosion site will be recorded on a field form and entered into a database. In addition, a photograph or photographs will be taken of each site. Completion of this evaluation will allow for a determination as to whether the erosion is Project related, and if so, how Project operations may be impacting the site.

Task 2: Determining the effects of erosion on other resources

The effects of shoreline erosion and riverbank failure on other resources should be determined. This will required coordination between studies to determine the effects of erosion on riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, and recreation. Erosion sites identified as having an impact on resources will be assess to determine if project operations are causing erosion and a mitigation plan to protect the resource of interest should be developed.

Task 3: Development of a Shoreline Management Plan

The information that is collected during the study should be used to develop a Shoreline Management Plan for the impoundment. Sites that are determined to impact important resources should be further evaluated to determine if there is a feasible way to reduce or stabilize the area. This feasibility analysis will be based on field observations and knowledge of current erosion control and slope failure stabilization methods that may be suitable for the site. The analysis will provide a preliminary list of potential control measures necessary to reduce erosion at these sites. Detailed analyses for final design and construction of erosion and slope stabilization control measures will not be part of the study. As part of this process, the landowner should be identified for each of the erosion site and future mitigation and stabilization techniques should be presented.

The study area for the shoreline erosion study should extend from the upstream end of the impoundment above the Bellows Falls Dam to the beginning of the impoundment below the Bellows Falls Dam. Water level fluctuations caused by the Project may affect not only the impoundment but also the downstream river reaches below the dam.

Level of Effort and Cost

The cost and effort of this study will be moderate, but is important to document the potential impact project operations on shoreline erosion and riverbank failure, and to determine how this may impact other resources.

Literature Cited

Kleinschmidt (Kleinschmidt Associates, Inc.). 2011. Lower Connecticut River Shoreline Survey Report – 2010: Bellows Falls Project (FERC No. 1855), Wilder Project (FERC No. 1892), Vernon Project (FERC No. 1904). Draft Report March 2011. Prepared for TransCanada Hydro Northeast Inc.,Westborough, MA.

Lawson, D.E., 1985, Erosion of northern reservoir shores: An analysis and application of pertinent literature: US Army Corps of Engineers Cold Regions Research and Engineering Laboratory Monograph 85-1, 198 p.

Simons, D.B., Andrews, J.W., Li, R.M., and Alawady, M.A. 1979. Connecticut River Streambank Erosion Study Massachusetts, New Hampshire, and Vermont. Prepared for USACE, New England Division.

Study Request 3. Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations for Vernon Dam

Goals and Objectives

The goal of this study is to determine how project operations contribute to the shoreline erosion and riverbank failure within the impoundment and downstream of the Vernon Hydroelectric Project.

The objectives of this study are to:

1. determine how water level fluctuations within the minimum and maximum operating range and discharges from peaking operations at the Wilder hydroelectric project contribute to shoreline erosion;
2. identify and determine the effects of shoreline bank erosion and riverbank failure on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.);
3. identify techniques that could be used to mitigate the effects of project operations or other mitigation techniques that could be developed to reduce on riverbank erosion within the impoundment and downstream of the tailrace.

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

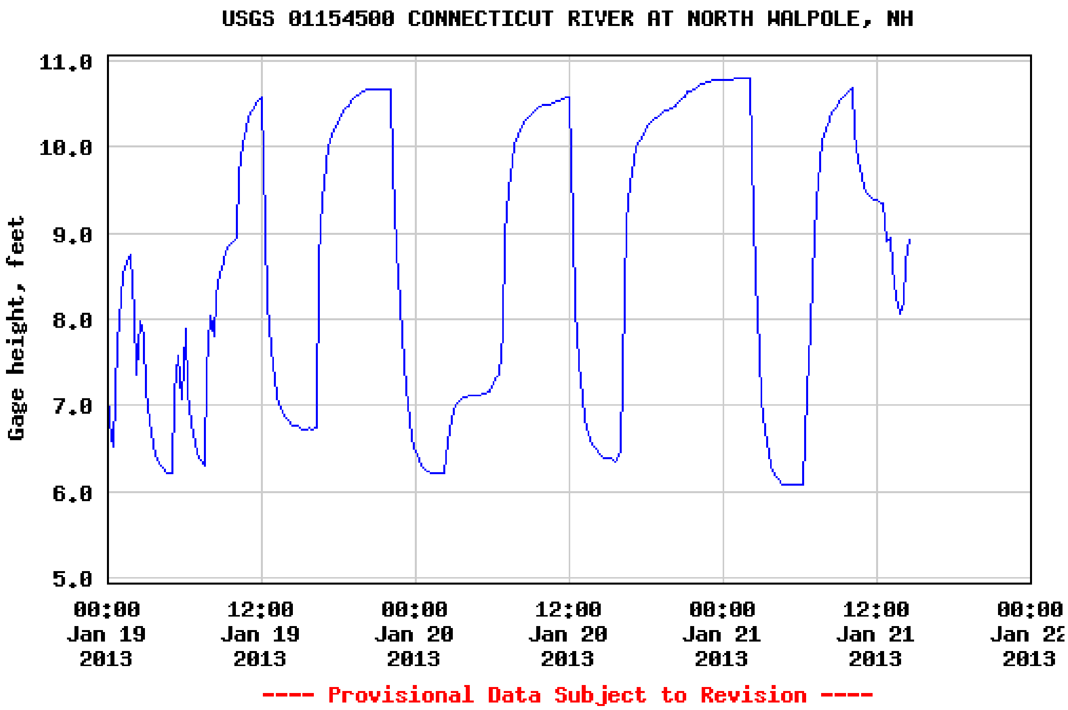
Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish, wildlife, plants, and their habitats are important public resources. There is a strong public interest in protecting, conserving, and enhancing these resources for public benefit, including wetlands, endangered species, and migratory species. Eroding shorelines and banks can degrade water quality, impairing aquatic life and habitat. This study will determine how project operations contribute to the shoreline erosion and riverbank failure within the impoundment and downstream of the Vernon Hydroelectric Project, providing important information for assessing potential degradation of aquatic life and habitat from project operations.

Existing Information

The PAD references several studies pertaining to shoreline erosion within the Connecticut River, including the study by US Army Corp of Engineers (Simion et al. 1979). This study evaluated the shoreline within the Wilder impoundment and identified water level fluctuation and periodic high flow events as causes of shoreline erosion. The PAD also discusses the erosion survey that TransCanada initiated 2010 to inventory sites where erosion is occurring within the Vernon impoundment (Kleinschmidt 2011). Bank slumping was identified as the major type of shoreline erosion within the project impoundment. Bank slumping can occur when fluvial erosional forces known as soil piping are acting on the toe of the bank slope, increasing the angle between the slope of the bank and water surface. The PAD did not address how project related operations contribute to shoreline erosion, could be changed to mitigate impacts on shoreline erosion, or discuss the impacts of shoreline erosion on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.).

Repetitive water level fluctuations and flow alterations caused by hydroelectric peaking operations are known to be a major contributor to shoreline erosion (Lawson 1985). Sediment from shoreline erosion and riverbank failure is one of the major contributors negatively affect water quality and habitat by increasing the turbidity and sedimentation, smothering aquatic habitat in United States. Vermont Surface Water Management Strategy identifies sediment from excessive channel erosion as a stressor on Vermont water and aquatic habitat. Additionally, Vermont lists this section of the Connecticut River on the Vermont Section 303(d) impaired water list due to flow alterations resulting from the destabilization and eroding of shoreline impairing aquatic life and habitat.

An example of the water level fluctuations that occur in Lower Connecticut River due to hydropower generation is shown below.



Project Nexus

Vernon Hydroelectric Project operations currently result in daily water level fluctuation in the impoundment by approximately 2 feet, which affects shoreline erosion in the impoundment by increasing the rate of soil piping. The project is currently permitted to water level fluctuation in the impoundment by 8 feet. Additionally the project “peaking” operation could contribute to bank erosion downstream of the dam by increasing the shear stress on the bank toe. TransCanada is not proposing any changes to project operations.

Proposed Methodology

We recommend TransCanada complete a study similar to the study completed by Kleinschmidt (2011). The study should be designed to build on erosion survey that was previously completed by determining the process causing erosion at a site, the extent erosion is negatively affecting other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.), and determining how erosion could be stabilized or mitigated by changing project operations. This study can be completed performing the following tasks.

Task 1: Determine erosion and riverbank failure process at identified sites

Shoreline erosion areas and riverbank failure sites were identified during the Kleinschmidt (2011) survey. Erosion sites that were identified during the previous survey should be revisited when the water level in the impoundment is at its lowest elevation, to collect information on erosion forces acting on the site, document if any additional erosion has occurred, and identified new sites of erosion within the impoundment. Erosion processes will be determined by field observations and applying site appropriate geology, geomorphic and hydrological principles. For each erosion site, the following erosion process element will be identified by determining soil type and subsoil characteristics (i.e. depth to bedrock, texture, rock content, signs of soil piping), reservoir water levels at the time of observation, water level fluctuation, climatic conditions, ground water seepage, wind-driven waves, boat waves, and recreation. Additional site characteristic to identify and record in the erosion survey will include but not be limited to an estimate of the length and average height of the erosional area, slope of the site, dominant vegetation cover types present, associated vegetation cover types present, an ocular estimate of total plant cover and total cover by plant class (tree, shrub, herbaceous) in surrounding undisturbed areas. **Riparian land use and presence/absence/size of vegetated buffer should be documented as well**. Data from each shoreline erosion site will be recorded on a field form and entered into a database. In addition, a photograph or photographs will be taken of each site. Completion of this evaluation will allow for a determination as to whether the erosion is Project related, and if so, how Project operations may be impacting the site.

Task 2: Determining the effects of erosion on other resources

The effects of shoreline erosion and riverbank failure on other resources should be determined. This will required coordination between studies to determine the effects of erosion on riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, and recreation. Erosion sites identified as having an impact on resources will be assess to determine if project operations are causing erosion and a mitigation plan to protect the resource of interest should be developed.

Task 3: Development of a Shoreline Management Plan

The information that is collected during the study should be used to develop a Shoreline Management Plan for the impoundment. Sites that are determined to impact important resources should be further evaluated to determine if there is a feasible way to reduce or stabilize the area. This feasibility analysis will be based on field observations and knowledge of current erosion control and slope failure stabilization methods that may be suitable for the site. The analysis will provide a preliminary list of potential control measures necessary to reduce erosion at these sites. Detailed analyses for final design and construction of erosion and slope stabilization control measures will not be part of the study. As part of this process, the landowner should be identified for each of the erosion site and future mitigation and stabilization techniques should be presented.

The study area for the shoreline erosion study should extend from the upstream end of the impoundment above the Vernon Dam to at least the New Hampshire / Massachusetts border. Water level fluctuations caused by the Project may affect not only the impoundment but also the downstream river reaches below the dam.

Level of Effort and Cost

The cost and effort of this study will be moderate, but is important to document the potential impact project operations on shoreline erosion and riverbank failure, and to determine how this may impact other resources.

Literature Cited

Kleinschmidt (Kleinschmidt Associates, Inc.). 2011. Lower Connecticut River Shoreline Survey Report – 2010: Bellows Falls Project (FERC No. 1855), Wilder Project (FERC No. 1892), Vernon Project (FERC No. 1904). Draft Report March 2011. Prepared for TransCanada Hydro Northeast Inc.,Westborough, MA.

Lawson, D.E., 1985, Erosion of northern reservoir shores: An analysis and application of pertinent literature: US Army Corps of Engineers Cold Regions Research and Engineering Laboratory Monograph 85-1, 198 p.

Simons, D.B., Andrews, J.W., Li, R.M., and Alawady, M.A. 1979. Connecticut River Streambank Erosion Study Massachusetts, New Hampshire, and Vermont. Prepared for USACE, New England Division.

Study Request 4. Climate Change as it Relates to Continued Operation of the Vernon, Bellows Falls, Wilder, Northfield Mountain Pumped Storage, and Turners Falls Projects

Goals and Objectives

The goal of this study is to determine how climate change relates to the continued operation of the Vernon, Bellows Falls, Wilder, Northfield Mountain Pumped Storage, and Turners Falls projects.

The objectives of this study are:

1. Quantify the amount of thermal loading contributed by each respective impoundment (including the NMPS upper reservoir).
2. Using climate change prediction models, calculate how much warmer the project impoundments are projected to get in the next 30-50 years.
3. Model the effect of various project modifications on river temperature under current conditions and climate change predictions (e.g., converting to run-of-river, deep-water releases, dam removal, large-scale riparian revegetation, etc.).
4. Using climate change prediction models, determine if the projects actually provide an environmental benefit with respect to mitigating against climate change impacts (vis a vis warming of air and water temperatures) by producing low greenhouse gas emitting energy. The Northfield Mountain Pump Storage assessment must be based on net energy production (i.e., NMPS generates1,143,038 MWh annually, but consumes 1,567,506 in its pumping operations; for a net consumption of 424,468 MWh annually).
5. Determine how climate change predictions will impact management of high flow events at the three projects and evaluate if changes to dam structures would mitigate adverse impacts of the existing flood management protocols.

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. The Connecticut River is a valued public resource, including the organisms (fish, wildlife, plants) that depend on river, wetland, bank and floodplain habitats for any part of their lifecycle. The public has a strong interest in protecting and enhancing these resources. Climate change poses the potential for increased water temperature in the dam impoundments and more frequent and more extreme high flow events, all of which can degrade or stress riverine and riparian habitats and resident and migratory wildlife populations dependent on the Connecticut River and its floodplain. This study will assess potential Climate Change caused effects and consider potential mitigating actions to minimize ecosystem degradation and enhance adaptation to a changing climate.

Existing Information

The PADs contains no information relative to climate change and how climate change predictions may impact future operation of the hydroelectric plants, nor of how the projects either mitigate for or exacerbate predicted climate change impacts to freshwater ecosystems.

TransCanada's PADs provide a summary of water quality data collected in 2012. Table 1 below is a synthesis of the temperature data collected by TransCanada. It should be noted that the upper and mid-impoundment stations at each project represent the average of temperature readings taken over the entire water column, while the continuous loggers (Lower Cont. and TR) were located near the water surface. These data indicate that from the upstream end of the Wilder headpond to the Vernon tailrace, water temperature increased approximately 6°C.

Table 1. Median water temperature at monitoring stations located within the impoundments and tailraces of the three hydropower projects.

	Median Water Temperature °C			
Project	Upper Imp.	Mid-Imp.	Lower Cont.	TR
Wilder	20.86	21.83	24.08	23.59
BF	22.43	23.67	24.86	24.38
Vernon	23.81	24.49	26.73	26.35

Relative to existing flood management protocols at each station, TransCanada's PADs identify that all three dams utilize stanchion bays (two at Vernon, three at Bellows Falls, and four at Wilder). When inflows to each dam reach certain levels, the stanchion bays are removed, and cannot be replaced until inflows subside. The depth of these bays and the flows they are removed at are outlined in Table 2, below.

Table 2. Summary of pertinent stanchion bay Information for the Vernon, Bellows Falls, and Wilder projects.

Project	Stanchion Height (feet)	Flow Triggering Complete Stanchion Removal
Wilder	17	145,000 cfs
BF	13	50,000 cfs
Vernon	10	105,000 cfs

The PADs provide no information on the history of stanchion removal at any of the projects (frequency, duration, timing), nor a discussion of how predicted climate change might alter management of the stanchion bays in the future (with respect to the frequency and seasonality of occurrence). There also is no discussion of potential impacts to headpond resources that occurs as a result of stanchion bay removal. These information gaps need to be filled in order to assess the relative and cumulative impact of project operations with respect to protecting river and floodplain habitats and the organisms that depend on them.

Data provided by the National Oceanic and Atmospheric Administration, Climate Data Center, illustrates long-term increasing air temperatures in the Northeast (Figure 1). Long-term, monthly mean water temperature data for the Vernon Dam impoundment, monitored by Vermont Yankee, has shown significant differences over time (ANOVA analyses, $P < 0.05$) that when plotted and further analyzed by linear regression, show a significant increasing trend for the period 1974 – 2011 for the months of January, September, and October (Figure 2). These analyses were performed with data from Vermont Yankee, analyzed by the Massachusetts Department of Environmental Protection.

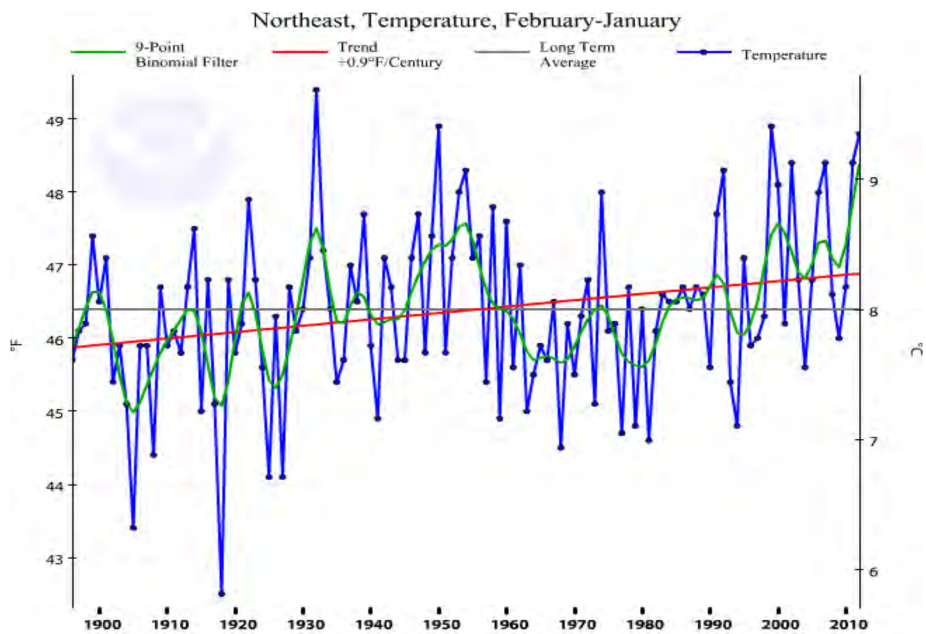


Figure 1. NOAA National Climate Data Center, Northeast 12-month average temperature for the period 1896 through 2012 (October).

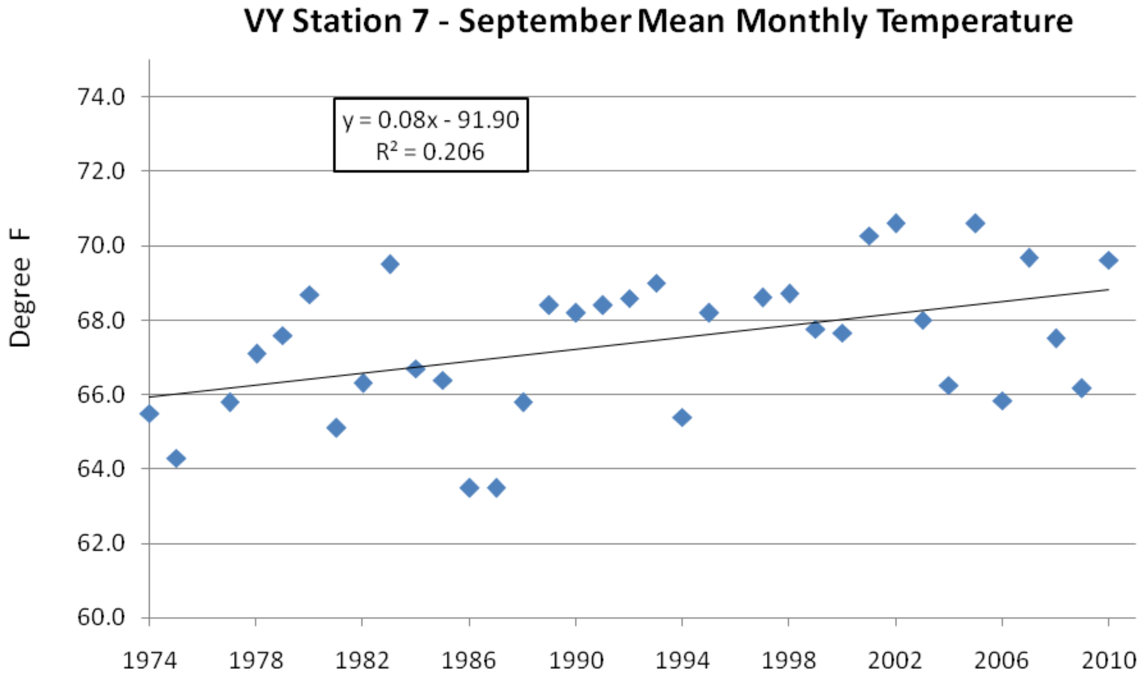


Figure 2. A plot of September's mean temperatures for Vermont Yankees' Station 7 (excludes outlier 1996 data point) for the period 1974 through 2011.

The PAD for Turners Falls and Northfield Mountain Pump Storage projects provides a summary of existing water quality data compiled by FirstLight. The PAD also notes a 1991 study by the former licensee that modeled thermal effects of pumping to the upper reservoir. That model reported a maximum temperature difference attributable to NMPS operation of 0.21°C in the Turners Falls reach of the Connecticut River in low flow (4,000 CFS) simulation.

Project Nexus

The four mainstem projects have very long impoundments capable of storing large volumes of water (Table 3, below). These impoundments effectively have converted large portions of the Connecticut River into a series of in-river "lakes." Because water velocities slow in these impounded sections of river, it allows for increased thermal loading and resultant higher water surface temperatures than in free-flowing sections of river.

Table 3. Relevant characteristics of the reservoirs behind the Wilder, Bellows Falls, Vernon, Turners Falls dams and NMPS.

Project	Headpond Length (miles)	Gross Storage Volume (acre-ft.)	Average Depth (ft.)	Surface Area (acres)	Flushing Rate (days)
Wilder	45	34,350	11	3,100	3
BF	26	26,900	10	2,804	<2
Vernon	26	40,000	16	2,550	2

Turners	20	21,500	2,110	
NMPS	n.a.	17,,050	246	n.a.

Depending on where the hydropower intakes withdraw water, these warmer surface waters may be discharged downstream, raising the temperature of those waters as well (the data in Table 1 above suggest that the projects do draw water from the upper levels of the reservoirs). This effect may be felt for miles downstream. If there are a series of impoundments (like on the Connecticut River), the cumulative impact is an overall warming of the river. Even small run-of-river dams have been shown to elevate downstream water temperature (Lessard and Hayes 2003; Saila et al. 2005). The most recent climate change prediction models specific to the northeast forecast warmer air temperatures, more frequent high precipitation events, more heat waves, and an increase in the incidence of short term droughts (Karl et al. 2009).

Resource concerns related to this project effect include the potential impacts to populations (reductions in abundance, structure, condition) or loss of species not tolerant of increases in temperature and other effects related to physiology such as energetic costs with warmer temperatures (Leggett 2004). As one example, American shad restoration target numbers for fish passage at mainstem dams into upstream historic habitat could be negatively impacted from artificially increased water temperatures. Water temperature has been identified as a factor in the timing (i.e., duration) of this species migration, as well as its role in gonad development and spawning (Glebe and Leggett 1981; Leggett 2004). These factors can be logical reasoned to potentially result in accelerated rates of energy reserve use and a reduced migration window, possibly reducing the ability of fish to reach up-river habitats and further reducing the ability to survive downstream outmigration.

With respect to project operations during high flow events, all TransCanada projects have stanchion bays that are used to manage water during high flow events. Each time these stanchion bays are removed, the headponds are lowered substantially (from 10 to 17 feet, depending on the project) and must remain lowered until inflows subside. Depending on the timing and duration of these deep drawdowns, headpond resources could be negatively impacted.

All of the dams also contain other mechanisms for managing flows, such as tainter gates, sluice gates, roller gates, skimmer gates and hydraulic flood gates. All of these gates have an advantage over stanchion bays in that they do not require flows to subside significantly before they can be closed to return impoundment levels back to normal. One climate change prediction for the northeast is that we will see more frequent high precipitation events which will result in high flow conditions on rivers. Therefore, it is likely that the stanchion bay removal protocol will have to be employed more frequently in the future.

Methodology Consistent with Accepted Practice

1. In order to quantify the amount of thermal loading contributed by each respective impoundment, detailed bathymetry will need to be collected. This bathymetry, combined with storage volume, tributary hydrology, and project operations, should be used to calculate the thermal loading of each headpond. The individual and cumulative increase in surface water temperature due to the impoundments should then be used to predict future warming based on climate change models.
2. Analyze different mitigation strategies to understand which have the greatest benefit in terms of building resilience against the impacts of climate change on water temperature. Potential scenarios to analyze include converting the projects to run-of-river, implementing deep-water releases, removing one or more dams, conducting large-scale riparian revegetation, etc.).

3. Input to climate change models the amount of GHG emissions that would be generated if fossil fuel plants were producing the equivalent amount of net energy as the five hydropower projects to determine the impact on air and surface water temperatures.
4. Climate change prediction model output should be assessed to determine if the frequency and timing of high flow events is likely to change in the future. If high flow events that necessitate initiating the stanchion bay removal protocol are predicted to increase in frequency and/or shift in timing, the applicant should evaluate structural and/or operational alternatives that would mitigate adverse impacts of the existing flood management protocols.

Level of Effort and Cost

The level of cost and effort for the thermal loading analysis would be low to moderate. Collecting bathymetry in the three TransCanada headponds would take two staff less than one week to collect (it took the Kansas Biological Survey two days to collect bathymetry at a 3,500 acre lake; Jakubauskas et al. 2011). Bathymetry for the Turners Falls pool and NMPS upper reservoir already exist. The remaining work would be desk-based; loading relevant information into an appropriate thermal loading model to compute the estimated thermal loading of each headpond and then comparing this information to surface water data from climate change prediction models.

The high flow flood protocol study is a desktop analysis that should require low cost and effort. Climate change models already exist and that output would be downloaded and analyzed. The remaining analysis requires a review of alternative means of managing flows without the use of stanchion bays.

The applicants did not propose any studies to meet this need in the PAD.

Literature Cited:

Jakubauskas, M., J. deNoyelles, E. A. Martinko. 2011. Bathymetric and Sediment Survey of Elk City Reservoir, Montgomery County, Kansas. Applied Science and Technology for Reservoir Assessment (ASTRA) Program, Lawrence, KS. Report No. 2010-01

Glebe, B. D. and W. C. Leggett. 1981. Latitudinal differences in energy allocation and use during the freshwater migration of American shad and their life history consequences. Canadian Journal of Fisheries and Aquatic Sciences 38, 806-820

Karl, T.R., Melillo, J.M., and T.C. Peterson. 2009. Global Climate Change Impacts in the United States. Cambridge University Press.

Leggett, W. C. 2004. The American shad, with special reference to its migration and population dynamics in the Connecticut River. Pages 181-238 in P. M. Jacobson, D. A. Dixon, W.C.

Leggett, B.C. Marcy, Jr., and R.R. Massengill, editors. The Connecticut River Ecological Study (1965-1973) revisited: ecology of the lower Connecticut River 1973-2003. American Fisheries Society. Monograph 9, Bethesda, MD.

Lessard, J.L. and D.B. Hayes. 2003. Effects of elevated water temperature on fish and Macroinvertebrate communities below small dams. River Research and Applications.

Saila, S.B., Poyer, D., and D. Aube. 2005. Small dams and habitat quality in low order streams. Wood-Pawcatuck Watershed Association. April 29, 2005. 16 pp.

Stier, D. J. and J. H. Crance. 1985. Habitat suitability index models and instream flow suitability curves: American shad. U. S. Fish and Wildlife Service Biological Report No. 82 (10.88), Washington D.C.

Study Request 5. Continuous water temperature monitoring (15 minute intervals) at various locations within the Wilder Hydroelectric Project Impoundment and Tailrace, and Connecticut River downstream of the Wilder Dam

Goals and Objectives

The goal of this study is to determine the potential impacts (both project specific and cumulative) of the Wilder Hydroelectric Project operations on hourly/daily temperature fluctuations and spatial thermal distribution within the Wilder Hydroelectric Project Impoundment and Tailrace**,** and the Connecticut River downstream of the Wilder Dam.

The objectives of this study are to:

1. Obtain continuous temperature data (every 15 minutes) at various locations and depths throughout the project impoundment, tailrace, and downstream Connecticut River using temperature loggers;
2. Analyze data for hourly/daily shifts in temperature regime and thermal distribution (aquatic isotherm maps) associated project specific and cumulative impacts associated with project operations; and
3. Determine if any shifts in hourly temperature regime or thermal distribution are impacting aquatic habitat within the project impoundment and tailrace and lower Connecticut River (e.g., thermal blocks to migration, thermal stress, habitat degradation).

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish, wildlife, plants, and their habitats are important public resources. There is a strong public interest in protecting, conserving, and enhancing these resources for public benefit, including wetlands, endangered species, and migratory species. Temperature is an important habitat consideration for many aquatic species including migratory fish and rare, threatened, endangered species. Temperature influences the distribution, behavior, metabolism, growth, reproduction, and survival of fishes (Diana 2004). This study will determine the potential impacts (both project specific and cumulative) of the Wilder Hydroelectric Project operations on hourly/daily temperature fluctuations and spatial thermal distribution within the Wilder Hydroelectric Project Impoundment and Tailrace**,** and the Connecticut River downstream of the Wilder Dam, providing important information for assessing potential thermal impacts to fish from project operations.

Existing Information

The PAD provides limited information on impacts of project operations ("daily run-of-river") on temperature in the project impoundment, tailrace or lower Connecticut River. Hourly/daily temperature shifts associated with project operations at Wilder Dam can impact aquatic habitat rendering it unsuitable for some organisms. The information in the PAD does not define the spatial extent of temperatures (aquatic isotherm map) within the impoundment, lower Connecticut River. The PAD mainly indicates that in general, temperature did increase from upstream to downstream while dissolved oxygen decreased, reflecting the impacts of the impoundment.

Project Nexus

The project impounds 45 miles of river that would otherwise be free flowing. It currently operates in a peaking mode, with allowable impoundment fluctuations of up to 5 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (675 cfs). Water temperature can be affected by the operating mode of a hydropower project. The impounded water increases the water surface area of the river reach containing the project. The increased surface acts as a large solar radiation collector and the thermal mass of the impounded water acts a heat sink storing heat from solar radiation. At night the increased surface area may act as convective radiator that releases heat. Together these attributes may contribute to unnatural thermal properties in the project impoundment that may impact natural temperature regime and influence habitat conditions for fish, wildlife and plant resources (temperature tolerance, life cycle timing (e.g., reproduction or migration), and food availability).

The project discharges regulated Connecticut River flows ("daily run-of-river") from the impoundment to the downstream seventeen mile reach of the Connecticut River. The project can sporadically release large volumes of impoundment water that may be of a different temperature than the receiving water downstream of the dam. Unnatural and rapid shifts in temperature regimes in the downstream water can impact fish, wildlife and plant resources and instream habitat. We request that more recent temperature data are collected in a more intensive, systematic and scientific manner in order to assess project specific and cumulative impacts on fish, wildlife and plant resources at the project. Results from this study may be used to directly inform the evaluation of project effects on related resources, such as a fish and other aquatic species.

Proposed Methodology

Use of temperature loggers to gain information on thermal trends has been a standard technique to look at impacts of water storage associated with hydroelectric projects. We recommend that transects be established in the upper, middle, and lower project impoundment, as well as in the tailrace and downstream project. An additional transect should be established in the free flowing section of river above the impoundment to serve as a "reference site". Inexpensive temperature loggers should be deployed along each transects at a minimum of three locations: at depths of 1 meter subsurface, mid-depth, and 1 meter off the bottom (on buoy lines) where water depths permit. The temperature loggers should be deployed from April 1 – November 15 and be set to record temperature at 15 minute intervals. The temperature loggers should be checked and the data downloaded on the monthly basis. The data from the loggers should then be used to develop hourly/daily aquatic isotherm maps, and temperature change and distribution as a result of project and cumulative impacts should be assessed.

Level of Effort and Cost

The effort and cost of this study is expected to be moderate to high, but the potential project specific and cumulative thermal alteration impacts have never been studied in a comprehensive manner and their potential impacts to aquatic habitat and fish, wildlife, and resources has not been adequately studied.

Literature Cited

Diana, J.S. 2004. Biology and Ecology of Fishes. 2nd edition. Biological Sciences Press.

Study Request 6. Continuous water temperature monitoring (15 minute intervals) at various locations within the Bellows Falls Hydroelectric Project Impoundment and Tailrace, and Connecticut River downstream of the Bellows Falls Dam

Goals and Objectives

The goal of this study is to determine the potential impacts (both project specific and cumulative) of the Bellows Falls Hydroelectric Project operations on hourly/daily temperature fluctuations and spatial thermal distribution within the Bellows Falls Hydroelectric Project Impoundment and Tailrace**,** and the Connecticut River downstream of the Bellows Falls Dam.

The objectives of this study are to:

1. Obtain continuous temperature data (every 15 minutes) at various locations and depths throughout the project impoundment, tailrace, and downstream Connecticut River using temperature loggers.
2. Analyze data for hourly/daily shifts in temperature regime and thermal distribution (aquatic isotherm maps) associated project specific and cumulative impacts associated with project operations.
3. Determine if any shifts in hourly temperature regime or thermal distribution are impacting aquatic habitat within the project impoundment and tailrace and lower Connecticut River (e.g., thermal blocks to migration, thermal stress, habitat degradation).

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish, wildlife, plants, and their habitats are important public resources. There is a strong public interest in protecting, conserving, and enhancing these resources for public benefit, including wetlands, endangered species, and migratory species. Temperature is an important habitat consideration for many aquatic species including migratory fish and rare, threatened, endangered species. Temperature influences the distribution, behavior, metabolism, growth, reproduction, and survival of fishes (Diana 2004). This study will determine the potential impacts (both project specific and cumulative) of the Bellows Falls Hydroelectric Project operations on hourly/daily temperature fluctuations and spatial thermal distribution within the Bellows Falls Hydroelectric Project Impoundment and Tailrace**,** and the Connecticut River downstream of the Bellows Falls Dam, providing important information for assessing potential thermal impacts to fish from project operations.

Existing Information

The PAD provides limited information on impacts of project operations ("daily run-of-river") on temperature in the project impoundment, tailrace or lower Connecticut River. Hourly/daily temperature shifts associated with project operations at Bellows Falls Dam can impact aquatic habitat rendering it unsuitable for some organisms. The information in the PAD does not define the spatial extent of temperatures (aquatic isotherm map) within the impoundment, lower Connecticut River. The PAD mainly indicates that in general, temperature did increase from upstream to downstream while dissolved oxygen decreased, reflecting the impacts of the impoundment.

Project Nexus

The project impounds 26 miles of river that would otherwise be free flowing. It currently operates in a peaking mode, with allowable impoundment fluctuations of up to 3 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1083 cfs). Water quality can be affected by the operating mode of a hydropower project. The PAD provides limited information on how project operations affect water quality within the project impoundment, bypass reach and tailrace. Water temperature can be affected by the operating mode of a hydropower project. The impounded water increases the water surface area of the river reach containing the project. The increased surface acts as a larger solar radiation collector and the thermal mass of the impounded water acts a heat sink storing heat from solar radiation. At night the increased surface area may act as convective radiator that releases heat. Together these attributes may contribute to unnatural thermal properties in the project impoundment that may impact natural temperature regime and influence habitat conditions for fish, wildlife and plant resources (temperature tolerance, life cycle timing (e.g., reproduction or migration), and food availability).

The project discharges regulated Connecticut River flows ("daily run-of-river") from the impoundment to the downstream seventeen mile reach of the Connecticut River. The project can sporadically release large volumes of impoundment water that may be of a different temperature than the receiving water downstream of the dam. Unnatural and rapid shifts in temperature regimes in the downstream water can impact fish, wildlife and plant resources and instream habitat. We request that more recent temperature data are collected in a more intensive, systematic and scientific manner in order to assess project specific and cumulative impacts on fish, wildlife and plant resources at the project. Results from this study may be used to directly inform the evaluation of project effects on related resources, such as a fish and other aquatic species.

Proposed Methodology

Use of temperature loggers to gain information on thermal trends has been a standard technique to look at impacts of water storage associated with hydroelectric projects. We recommend that transects be established in the upper, middle, and lower project impoundment, as well as in the tailrace and downstream project. An additional transect should be established in the free flowing section of river above the impoundment to serve as a "reference site". Inexpensive temperature loggers should be deployed along each transects at a minimum of three locations: at depths of 1 meter subsurface, mid-depth, and 1 meter off the bottom (on buoy lines) where water depths permit. The temperature loggers should be deployed from April 1 – November 15 and be set to record temperature at 15 minute intervals. The temperature loggers should be checked and the data downloaded on the monthly basis. The data from the loggers should then be used to develop hourly/daily aquatic isotherm maps, and temperature change and distribution as a result of project and cumulative impacts should be assessed.

Level of Effort and Cost

The effort and cost of this study is expected to be moderate to high, but the potential project specific and cumulative thermal alteration impacts have never been studied in a comprehensive manner and their potential impacts to aquatic habitat and fish, wildlife, and resources has not been adequately studied.

Literature Cited

Diana, J.S. 2004. Biology and Ecology of Fishes. 2nd edition. Biological Sciences Press.

Study Request 7. Continuous water temperature monitoring (15 minute intervals) at various locations within the Vernon Hydroelectric Project Impoundment and Tailrace, and Connecticut River downstream of the Vernon Dam

Goals and Objectives

The goal of this study is to determine the potential impacts (both project specific and cumulative) of the Vernon Hydroelectric Project operations on hourly/daily temperature fluctuations and spatial thermal distribution within the Vernon Hydroelectric Project Impoundment and Tailrace**,** and the Connecticut River downstream of the Vernon Dam.

The objectives of this study are to:

1. Obtain continuous temperature data (every 15 minutes) at various locations and depths throughout the project impoundment, tailrace, and downstream Connecticut River using temperature loggers.
2. Analyze data for hourly/daily shifts in temperature regime and thermal distribution (aquatic isotherm maps) associated project specific and cumulative impacts associated with project operations.
3. Determine if any shifts in hourly temperature regime or thermal distribution are impacting aquatic habitat within the project impoundment and tailrace and lower Connecticut River (e.g., thermal blocks to migration, thermal stress, habitat degradation).

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish, wildlife, plants, and their habitats are important public resources. There is a strong public interest in protecting, conserving, and enhancing these resources for public benefit, including wetlands, endangered species, and migratory species. Temperature is an important habitat consideration for many aquatic species including migratory fish and rare, threatened, endangered species. Temperature influences the distribution, behavior, metabolism, growth, reproduction, and survival of fishes (Diana 2004). This study will determine the potential impacts (both project specific and cumulative) of the Vernon Hydroelectric Project operations on hourly/daily temperature fluctuations and spatial thermal distribution within the Vernon Hydroelectric Project Impoundment and Tailrace**,** and the Connecticut River downstream of the Vernon Dam, providing important information for assessing potential thermal impacts to fish from project operations.

Existing Information

The PAD provides limited information on impacts of project operations ("daily run-of-river") on temperature in the project impoundment, tailrace or lower Connecticut River. Hourly/daily temperature shifts associated with project operations at Vernon Dam can impact aquatic habitat rendering it unsuitable for some organisms. The information in the PAD does not define the spatial extent of temperatures (aquatic isotherm map) within the impoundment, lower Connecticut River. The PAD mainly indicates that in general, temperature did increase from upstream to downstream while dissolved oxygen decreased, reflecting the impacts of the impoundment.

Project Nexus

The project impounds 26 miles of river that would otherwise be natural free-flowing. It currently operates in a peaking mode, with allowable impoundment fluctuations of up to 8 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1250 cfs). Water temperature can be affected by the operating mode of a hydropower project. The impounded water increases the water surface area of the river reach containing the project. The increased surface acts as a larger solar radiation collector and the thermal mass of the impounded water acts a heat sink storing heat from solar radiation. At night the increased surface area may act as convective radiator that releases heat. Together these attributes may contribute to unnatural thermal properties in the project impoundment that may impact natural temperature regime and influence habitat conditions for fish, wildlife and plant resources (temperature tolerance, life cycle timing (e.g., reproduction or migration), and food availability).

The project discharges regulated Connecticut River flows ("daily run-of-river") from the impoundment to the downstream seventeen mile reach of the Connecticut River. The project can sporadically release large volumes of impoundment water that may be of a different temperature than the receiving water downstream of the dam. Unnatural and rapid shifts in temperature regimes in the downstream water can impact fish, wildlife and plant resources and instream habitat. We request that more recent temperature data are collected in a more intensive, systematic and scientific manner is needed to assess project specific and cumulative impacts on fish, wildlife and plant resources at the project. Results from this study may be used to directly inform the evaluation of project effects on related resources, such as a fish and other aquatic species.

Proposed Methodology

Use of temperature loggers to gain information on thermal trends has been a standard technique to look at impacts of water storage associated with hydroelectric projects. We recommend that transects be established in the upper, middle, and lower project impoundment, as well as in the tailrace and downstream project. An additional transect should be established in the free flowing section of river above the impoundment to serve as a "reference site". Inexpensive temperature loggers should be deployed along each transects at a minimum of three locations: at depths of 1 meter subsurface, mid-depth, and 1 meter off the bottom (on buoy lines) where water depths permit. The temperature loggers should be deployed from April 1 – November 15 and be set to record temperature at 15 minute intervals. The temperature loggers should be checked and the data downloaded on the monthly basis. The data from the loggers should then be used to develop hourly/daily aquatic isotherm maps, and temperature change and distribution as a result of project and cumulative impacts should be assessed.

Level of Effort and Cost

The effort and cost of this study is expected to be moderate to high, but the potential project specific and cumulative thermal alteration impacts have never been studied in a comprehensive manner and their potential impacts to aquatic habitat and fish, wildlife, and resources has not been adequately studied.

Literature Cited

Diana, J.S. 2004. Biology and Ecology of Fishes. 2nd edition. Biological Sciences Press.

Study Request 8. Water quality monitoring within the project impoundment and tailrace, Wilder Hydroelectric Project

Goals and Objective

The goal of this study is to determine if the operational impacts of the Wilder Hydroelectric Project are causing or contributing to violations of New Hampshire and/or Vermont state water quality standards.

The objective of this study will be to collect water temperature, dissolved oxygen, specific conductance, pH, nutrients, and chlorophyll-a data at multiple locations in the project area. This monitoring effort will consist of both instantaneous measurements and continuous data collected via multi-parameter dataloggers. Data should be collected under normal operating conditions and ambient conditions that include periods of low flow and higher water temperatures. Weekly profiles and grab samples should reflect various flow conditions. The water quality data will be compared to both Vermont and New Hampshire water quality standards to determine if the project is causing or contributing to water quality standard violations.

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. The Connecticut River is a valued public resource. The public has a strong interest in protecting the water quality of the Connecticut River. This study will determine if the operational impacts of the Wilder Hydroelectric Project are causing or contributing to violations of New Hampshire and/or Vermont state water quality standards.

Existing Information

The PAD contains information on water quality monitoring that was completed between June 20, 2012 and September 11, 2012 in the tailrace and just upstream of the dam. The data indicated that Vermont Water Quality Standards for dissolved oxygen were not met during a seven day period in August. The PAD does not provide information on the water quality throughout the impoundment or how water quality is affected by project operations. The PAD does indicate that in general temperature, specific conductance, and pH did increase from upstream to downstream while dissolved oxygen decreased, reflecting the impacts of the impoundment.

Project Nexus

The project impounds 45 miles of river that would otherwise be free flowing. It currently operates in a peaking mode, with allowable impoundment fluctuations of up to 5 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (675 cfs). Water quality can be affected by the operating mode of a hydropower project. The PAD provides limited information on how project operations affect water quality within the project impoundment and tailrace.

Operations of the project must conform to Vermont and New Hampshire water quality standards. We request a study that will provide the data needed to determine if the Connecticut River in the vicinity of the Wilder Hydroelectric Project is or is not attaining the water quality standards of both states.

Proposed Methodology

The methodology for this study should be similar to TransCanada's water quality monitoring in 2012 including weekly vertical profiles within the impoundment, weekly water quality samples of nutrients and chlorophyll-a for laboratory analysis and the deployment of multi-parameter continuous dataloggers at multiple locations within the impoundment and tailrace. An additional site should be monitored in the free flowing section of the river above the impoundment to serve as a "reference site". At each designated datalogger monitoring location at least 10 days of data should be collected at 15 minute increments during a period of low flow ($\leq$3 x 7Q10) and high temperatures (preferably over 23 degrees C) between June 1 and September 30. Dataloggers deployed in the impoundment should be set at the bottom of the epilimnion (if stratified) or at 25% depth if not stratified. A vertical dissolved oxygen and water temperature profile should be conducted at the time of deployment of dataloggers in the impounded section to determine if river is stratified and thus the appropriate depth for deployment. Water quality results should be graphically compared to both state water quality standards and project operations, including the generation status, impoundment elevation, and discharge.

If low flow conditions are not met the first year of the study, a second year of data may be necessary.

It is preferable that the water quality monitoring for all three projects be coordinated so that sampling can occur at each location within each project during the same period of time and under the same operational, flow, and environmental conditions.

Level of Effort and Cost

The cost and effort of this study will be moderate, but is important to document the potential impact operations have on water quality and determine if they meet Vermont and New Hampshire water quality standards.

Study Request 9. Water quality monitoring within the project impoundment and tailrace, Bellows Falls Hydroelectric Project

Goals and Objective

The goal of this study is to determine if the operational impacts of the Bellows Falls Hydroelectric Project are causing or contributing to violations of New Hampshire and/or Vermont state water quality standards.

The objective of this study will be to collect water temperature, dissolved oxygen, specific conductance, pH, nutrients, and chlorophyll-a data at multiple locations in the project area. This monitoring effort will consist of both instantaneous measurements and continuous data collected via multi-parameter dataloggers. Data should be collected under normal operating conditions and ambient conditions that include periods of low flow and higher water temperatures. Weekly profiles and grab samples should reflect various flow conditions. The water quality data will be compared to both Vermont and New Hampshire water quality standards to determine if the project is causing or contributing to water quality standard violations.

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. The Connecticut River is a valued public resource. The public has a strong interest in protecting the water quality of the Connecticut River. This study will determine if the operational impacts of the Bellows Falls Hydroelectric Project are causing or contributing to violations of New Hampshire and/or Vermont state water quality standards.

Existing Information

The PAD contains information on water quality monitoring that was completed between June 20, 2012 and September 12, 2012 in the tailrace, bypass reach and just upstream of the dam. Additionally, weekly water column profiles were collected at three locations within the impoundment. The data indicated that Vermont and New Hampshire water quality standards for dissolved oxygen were not met in the bypass reach and in the impoundment. Furthermore, pH readings collected in water profile measurements indicated that in two different locations during two separate events in the impoundment did not meet Vermont and New Hampshire water quality standards. The PAD does not provide information on the continuous water quality throughout the impoundment or how water quality is affected by project operations. The PAD indicates that in general temperature, specific conductance, and pH did increase from upstream to downstream while dissolved oxygen decreased, reflecting the impacts of the impoundment.

Project Nexus

The project impounds 26 miles of river that would otherwise be free flowing. It currently operates in a peaking mode, with allowable impoundment fluctuations of up to 3 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1083 cfs). Water quality can be affected by the operating mode of a hydropower project. The PAD provides limited information on how project operations affect water quality within the project impoundment, bypass reach and tailrace.

Operations of the project must conform to Vermont and New Hampshire water quality standards. We request a study that will provide the data needed to determine if the Connecticut River in the vicinity of the Wilder Hydroelectric Project is or is not attaining the water quality standards of both states.

Proposed Methodology

The methodology for this study should be similar to TransCanada's water quality monitoring in 2012 including weekly vertical profiles within the impoundment, weekly water quality samples of nutrients and chlorophyll-a for laboratory analysis and the deployment of multi-parameter continuous dataloggers at multiple locations within the impoundment, the bypass reach, and tailrace. An additional site should be monitored in the 17 mile free flowing section of the river above the impoundment to serve as a "reference site". At each designated datalogger monitoring location at least 10 days of data should be collected at 15 minute increments during a period of low flow ($\leq$3 x 7Q10) and high temperatures (preferably over 23 degrees C) between June 1 and September 30. Dataloggers deployed in the impoundment should be set at the bottom of the epilimnion (if stratified) or at 25% depth if not stratified. A vertical dissolved oxygen and water temperature profile should be conducted at the time of deployment of dataloggers in the impounded section to determine if river is stratified and thus the appropriate depth for deployment. Water quality results should be graphically compared to both state water quality standards and project operations, including the generation status, impoundment elevation, and discharge.

If low flow conditions are not met the first year of the study, a second year of data may be necessary.

It is preferable that the water quality monitoring for all three projects be coordinated so that sampling can occur at each location within each project during the same period of time and under the same operational, flow, and environmental conditions.

Level of Effort and Cost

The cost and effort of this study will be moderate, but is important to document the potential impact operations have on water quality and determine if they meet Vermont and New Hampshire water quality standards.

Study Request 10. Water quality monitoring within the project impoundment and tailrace, Vernon Hydroelectric Project

Goals and Objective

The goal of this study is to determine if the operational impacts of at the Vernon Hydroelectric Project are causing or contributing to violations of New Hampshire and/or Vermont state water quality standards.

The objective of this study will be to collect water temperature, dissolved oxygen, specific conductance, pH, nutrients, and chlorophyll-a data at multiple locations in the project area. This monitoring effort will consist of both instantaneous measurements and continuous data collected via multi-parameter dataloggers. Data should be collected under normal operating conditions and ambient conditions that include periods of low flow and higher water temperatures. Weekly profiles and grab samples should reflect various flow conditions. The water quality data will be compared to both Vermont and New Hampshire water quality standards to determine if the project is causing or contributing to water quality standard violations.

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. The Connecticut River is a valued public resource. The public has a strong interest in protecting the water quality of the Connecticut River. This study will determine if the operational impacts of the Vernon Falls Hydroelectric Project are causing or contributing to violations of New Hampshire and/or Vermont state water quality standards.

Existing Information

The PAD contains information on water quality monitoring that was completed between June 20, 2012 and September 11, 2012 in the tailrace and just upstream of the dam. Temperature data indicated that it reached levels that would be critical threshold for salmonids, and above the natural regime for the river. The PAD does not provide information on the water quality throughout the impoundment or how water quality is affected by project operations. The PAD does indicates that in general temperature, specific conductance, and pH did increase from upstream to downstream while dissolved oxygen decreased, reflecting the impacts of the impoundment on increase travel time in the river.

Project Nexus

The project impounds 26 miles of river that would otherwise be natural free-flowing. It currently operates in a peaking mode, with allowable impoundment fluctuations of up to 8 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1250 cfs). Water quality can be affected by the operating mode of a hydropower project. The PAD provides limited information on how project operations affect water quality within the project impoundment and tailrace.

Operations of the project must conform to Vermont and New Hampshire water quality standards. We request a study that will provide the data needed to determine if the Connecticut River in the vicinity of the Wilder Hydroelectric Project is or is not attaining the water quality standards of both states.

Proposed Methodology

The methodology for this study should be similar to TransCanada's water quality monitoring in 2012 including weekly vertical profiles within the impoundment, weekly water quality samples of nutrients and chlorophyll-a for laboratory analysis and the deployment of multi-parameter continuous dataloggers at multiple locations within the impoundment and tailrace. An additional site should be monitored in the free flowing section of the river above the impoundment to serve as a "reference site". At each designated datalogger monitoring location at least 10 days of data should be collected at 15 minute increments during a period of low flow ($\leq$3 x 7Q10) and high temperatures (preferably over 23 degrees C) between June 1 and September 30. Dataloggers deployed in the impoundment should be set at the bottom of the epilimnion (if stratified) or at 25% depth if not stratified. A vertical dissolved oxygen and water temperature profile should be conducted at the time of deployment of dataloggers in the impounded section to determine if river is stratified and thus the appropriate depth for deployment. Water quality results should be graphically compared to both state water quality standards and project operations, including the generation status, impoundment elevation, and discharge.

If low flow conditions are not met the first year of the study, a second year of data may be necessary.

It is preferable that the water quality monitoring for all three projects be coordinated so that sampling can occur at each location within each project during the same period of time and under the same operational, flow, and environmental conditions.

Level of Effort and Cost

The cost and effort of this study will be moderate, but is important to document the potential impact project operations have on water quality and determine if they meet Vermont and New Hampshire water quality standards.

Study Request 11. Model River Flows and Water Levels Upstream and Downstream from the Wilder, Bellows Falls, and Vernon Stations and Integration of Project Modeling with Downstream Project Operations

Goals and Objectives

The goal of this study is to develop river flow models that permit the evaluation of the hydrologic changes to the river caused by the physical presence and operation of the Wilder, Bellows Falls, and Vernon Hydroelectric Projects and the interrelationships between the operation of all five hydroelectric projects up for relicensing and river inflows. Specific objectives of this study include:

1. Conduct quantitative hydrologic modeling of the hydrologic influences and interactions that exist between the water surface elevations of the Wilder, Bellows Falls, and Vernon project impoundments and discharges from the Wilder, Bellows Falls, and Vernon projects and the downstream hydroelectric projects including:
    a. Inflows into the Wilder, Bellows Falls, and Vernon impoundments from the Fifteen Mile Falls Project, FERC No. 2007, and other sources;
    b. Existing and potential discharges from the Wilder, Bellows Falls, and Vernon project generating facilities and spill flows, including existing and potential minimum flow and other operational requirements;
    c. Existing and potential water level fluctuation restrictions (maximum and minimum pond levels) of the Wilder, Bellows Falls, and Vernon impoundments, and consequent changes in downstream project discharges; and
    d. Incorporation of the potential effects of climate-altered flows on project operations over the course of the license.
2. Assess how existing and potential operations of the Wilder, Bellows Falls, and Vernon projects affect the operations of the Northfield Mountain and Turners Falls Projects, including:
    a. How Wilder, Bellows Falls, and Vernon flow fluctuations affect pool levels of the Turners Falls impoundment; and
    b. How operations of the Wilder, Bellows Falls, and Vernon projects affect Turners Falls discharges.
3. Assess impacts on recreational use upstream and downstream of each dam.

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. The Connecticut River is a valued public resource, including the organisms (fish, wildlife, plants) that depend on river, wetland, bank and floodplain habitats for any part of their lifecycle. The public has a strong interest in protecting and enhancing these resources. This study will develop river flow models that permit the evaluation of the hydrologic changes to the river caused by the physical presence and operation of the Wilder, Bellows Falls, and Vernon Hydroelectric Projects and the interrelationships between the operation of all five hydroelectric projects up for relicensing and river inflows. This study will provide important information for assessing potential impacts from project operations to the ecosystems, habitats and wildlife of the Connecticut River.

Existing Information

Available information in the PAD does not indicate how project operations have altered the hydrology downstream from each of these facilities, which may affect resident and migratory fish, macroinvertebrates, rare, threatened and endangered species, aquatic plants and other biota and natural processes in the Connecticut River. It is also unclear how operations at one facility affect the operations at another.

Project Nexus

The Wilder, Bellows Falls, and Vernon projects are each currently operated with required minimum flows of 675, 1,083, and 1,250 cfs (or inflows if less) for each facility, respectively, though in practice minimum flows are operated as 700, 1300, and 1600 cfs, respectively. There is presently no required minimum flow for the bypassed reach of the Bellows Falls Project. Each of the projects operates as a daily peaking facility, such that “Generation can vary during the course of any day between the required minimum flow and full capacity if higher flows are available” (p. 2-28, p. 2-29, and p. 2-30 in the Wilder, Bellows Falls and Vernon PADs, respectively). Total hydraulic capacity of each facility is 12,700, 11,010, and 12,634 cfs, respectively. Regular daily fluctuations on the order of 9,000 cfs or greater are commonly recorded at USGS gages 01144500 (Connecticut River at West Lebanon, below Wilder Dam) and 01154500 (Connecticut River at North Walpole, NH, below Bellows Falls Dam). Daily fluctuations in headpond elevation are approximately 2.5’ (382’ to 384.5’ MSL), 1.2’ (289.9’ to 291.1’ MSL), and 1.2’ (218.6’ to 219.8’ MSL) at the Wilder, Bellows Falls, and Vernon impoundments, respectively.

These described changes affect biotic habitat and biota upstream and downstream of each project. Project operations and potential changes to operations to mitigate impacts at each facility are influenced by inflows and operations of upstream projects. Results of river flow analyses will provide necessary information regarding changes that can be made to the Wilder, Bellows Falls, and Vernon Project flow releases and/or water level restrictions, how such changes may be constrained by inflows and upstream project operations, and how these changes potentially affect downstream resources. This information will then be used to develop flow-related license requirements and/or other mitigation measures.

Proposed Methodology

River hydrology statistics and hourly flow modeling are commonly employed at hydroelectric projects to assess implications of project operations on the river environment.

Level of Effort and Cost

Level of effort and cost of model development are expected to be moderate as much of the baseline modeling has already been completed, but running of various scenarios through the model(s) will be needed throughout the relicensing process to assess the implications of changes to the operations of each project on other projects and other resources. The modeling exercise will also require coordination and cooperation between TransCanada and the downstream licensee to assure that the model inputs and outputs can be accurately related.

We would anticipate that the expected level of effort and anticipated costs will be comparable to that experienced on similar FERC relicensing projects of this size (e.g., Conowingo, FERC No. 405).

Study Request 12. Bellows Falls Bypass Flow

Goals and Objectives

The goal of this study is to determine appropriate bypass flows that will protect and enhance the aquatic resources of the Bellows Falls bypass reach.

The objective of the study will be to evaluate the relationship between flow and habitat suitability in the bypass reach.

Relevant Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish, wildlife, plants, and their habitats are important public resources. There is a strong public interest in protecting, conserving, and enhancing these resources for public benefit, including wetlands, endangered species, and migratory species. This study will determine appropriate bypass flows that will protect and enhance the aquatic resources of the Bellows Falls bypass reach.

Existing Information

The Bellows Falls Project bypasses a 3,500 foot-long section of the Connecticut River. Presently this bypass reach only receives flow when inflow exceeds the hydraulic capacity of the Bellow Falls station. According to exceedance curves provided in the PAD, on a monthly basis the bypass reach receives flow the following amount of time:

Month	**% time flow > 11,000 cfs**	**Month**	**% Time Flow >11,000 cfs**
Jan.	15	July	10
Feb.	15	August	8
March	50	Sept.	4
April	90	Oct.	20
May	60	Nov.	35
June	20	Dec.	26

No information exists on the adequacy of the existing bypass flow regime to protect water quality and aquatic life. The bypass reach receives flow less than 30% of the time on an annual basis. While TransCanada did conduct a preliminary water quality study in the summer of 2012 that indicated water quality at the bypass reach sample station was not meeting state water quality standards, only a summary of the data are provided in the PAD. It does not indicate where the sonde was located, nor the bypass reach conditions during the study period (e.g., what was the flow into the bypass reach during the study? Was the sonde located in the only wetted area of the bypass reach?). Further, the PAD provides no detailed description of the physical or biological characteristics of the bypass reach.

An empirical study is needed to provide information on the relationship between flow and habitat in the bypass reach for the Service to use in determining appropriate flows in the bypass reach.

Project Nexus

The Project includes a 3,500-foot-long bypass reach. Absent a mandated discharge at the dam, this habitat would remain dewatered during those times when inflow was within the hydraulic capacity of the units (~70% of the time on an annual basis). The existing license does not require any flow through the bypass reach. The current situation does not sufficiently protect the aquatic resources inhabiting or potentially inhabiting the bypass reach.

The Connecticut River in the project vicinity is dominated by sections that are impounded, backwatered from downstream impoundments or otherwise deep and slow-flowing. In contrast, the Bellows Falls bypass channel is very irregular and diverse, consisting of both coarse substrate of various sizes and in the more downstream segment, jagged, irregular ledge. Given an adequate flow regime, the bypass could provide habitat types that are now rare and therefore of great importance.

Results of the flow study will be used by the Service to determine an appropriate flow recommendation that will protect and/or enhance the aquatic resources in the bypass reach for the duration of any new license issued by the Commission.

Proposed Methodology

We request a bypass flow study be conducted at the Project. Bypass flow habitat assessments are commonly employed in developing flow release protocols that will reduce impacts or enhance habitat conditions in reaches of river bypassed by hydroelectric projects.

Given the size of the bypass reach (3,500 feet long) and the rareness of the habitat types it contains in this portion of the Connecticut River, we believe a study methodology that utilizes an IFIM approach is appropriate for this site. This same protocol was used during the relicensing of the Housatonic River Project (FERC No. 2576),[1]and has been accepted by the Commission in other licensing proceedings[2].

Given the unique channel formation habitat modeling using standard PHABSIM 1 dimensional modeling may not be sufficient to assess the habitat suitability in the bypass reach but rather 2 dimensional, 2D modeling may be needed to better characterize flows and velocities in this reach. We recommend that the approach to habitat modeling be determined during the study plan development stage based on consultations between the applicant and the resource agencies.

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[1] Housatonic River Project License Application, Volume 4, Appendix F. Connecticut Light and Power Company, August 1999.

[2] Glendale Project (FERC No. 2801) Final Bypass Reach Aquatic Habitat and Instream Flow Study in Glendale Hydroelectric Project Application for Subsequent License (FERC No. 2801), Volume 2, Appendix B, pages 7-8, October 2007.

Level of Effort and Cost

The expected level of effort and anticipated costs will be comparable to that experienced on similar FERC relicensing projects of this size.

Field work for flow studies can be reasonably extensive but will depend on consultation with the applicant on study methodology and on-site decisions on locations for data collection and the number of collection locations. Post-fieldwork data analysis would be a moderate cost and effort. Field work associated with this study could be done in conjunction with the Instream Flow Study Request. We anticipate that the level of effort and costs will be comparable to that experienced on similar FERC relicensing projects (e.g., the Glendale Project, FERC No. 2801).

Study Request 13. Channel Morphology and Benthic Habitat Impacts at the Vernon, Bellows Falls and Wilder Projects

It is well known that dams interrupt the downstream continuum of sediment supply and transport, which in turn can affect channel morphology and limit the amount of coarse (i.e. gravel/cobble) substrate available for aquatic biota. The Vernon, Bellows Falls and Wilder projects' effects on fluvial processes, channel formation and associated anadromous and riverine fish habitat, as well as aquatic invertebrate habitat, is unclear. This study request aims to provide information on coarse sediment supply and transport as it relates to aquatic benthic habitat (e.g. gravel bars). Results will be used to identify techniques to minimize and/or mitigate impacts to this valuable habitat.

Goals and Objectives

The goal of this study is to understand how the projects affect bedload distribution, particle size and composition as it relates to habitat availability (amount and size of coarse substrate material) for different life-history stages of anadromous (e.g. sea lamprey) and riverine fishes (e.g. walleye), as well as invertebrates (e.g. mussels, tiger beetles).

The study objectives include:

1. Assess the distribution and extent of the existing substrate types, including gravel and cobble bars within the project affected areas.
2. Identify the current conditions of the channel and determine the stability of the present substrate/benthic habitat and identify if flow or sediment measures are necessary to improve the aquatic benthic habitat.

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish, wildlife, plants, and their habitats are important public resources. There is a strong public interest in protecting, conserving, and enhancing these resources for public benefit, including wetlands, endangered species, and migratory species. The Vernon, Bellows Falls and Wilder projects' effects on fluvial processes, channel formation and associated anadromous and riverine fish habitat, as well as aquatic invertebrate habitat, is unclear. Many fish species and aquatic invertebrates (e.g., fresh water mussels, snails, worms, and aquatic insects) live on or near gravel habitat, because it provides a source of food and cover (Miller 1988). Gravel bars also play an important role in water quality, hydrology, and morphology of rivers (Lewis 2005). This study will assess how the projects affect bedload distribution, particle size and composition as it relates to habitat availability (amount and size of coarse substrate material) for different life-history stages of anadromous (e.g. sea lamprey) and riverine fishes (e.g. walleye), as well as invertebrates (e.g. mussels, tiger beetles).

Existing Information

The PAD generally focusses on erosional impacts due to the projects' operations, but lacks specific information on fluvial geomorphic processes and substrate composition as it relates to impacts to aquatic benthic habitat.

Project Nexus

The projects impound a large portion of the Lower Connecticut River that otherwise would be free flowing and would transport fine sediment downstream leaving larger substrate material (gravel/cobble) exposed to be utilized by aquatic biota. Currently, the projects operate as hydro-peaking facilities; with large water releases below the dam that increase shear stress on the river bed, substrate is mobilized that otherwise would only be moved during seasonal high flow events. Operations of the existing TransCanada hydroelectric projects likely affect channel morphology and fluvial processes including substrate mobility, and particle size distribution. Project-induced changes to natural fluvial processes and channel morphology and substrate composition can have negative impacts on aquatic resources. For example, changes in sediment composition could relocate or decrease important walleye and sea lamprey spawning habitat. In a similar fashion, project-induced changes could make some habitats unsuitable for aquatic invertebrates, including the federally-endangered dwarf wedgemussel. We request a study investigating the impacts of project operations on fluvial processes, substrate composition and stability as it relates to aquatic benthic habitat. Results of this study will be used to develop potential license requirements to protect aquatic habitat in the project-affected areas, and may be used to inform other studies that evaluate project effects on related resources.

Proposed Methodology

Geomorphology studies are common in hydroelectric relicensing projects to determine channel condition, and substrate composition, and determine whether changes in project operations or sediment measures are necessary and/or whether channel restoration is necessary to improve aquatic benthic habitat. We recommend a methodology similar to previously approved FERC studies (FERC No. 2246 and 2206). The study plan should be developed in consultation with the Agency. Specific study methods recommended for this study can be found in the FERC Project No. 2246, Yuba County Water Agencies Study Plan Determination: Study 1.1. for specific methods. Lemonds (2006) also conducted an empirical-based study for the Yadkin-Pee Dee River Hydroelectric Project No. 2206

Level of Effort and Cost

The study would require gathering existing information, developing maps, and utilizing high- resolution digital imagery. Field work would be moderate. TransCanada does not propose any studies to meet this need.

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Study Request 14. In-stream Flow Habitat Assessment Downstream of Wilder, Bellows Falls, and Vernon Dams

Goals and Objectives

The goal of this study is to determine an appropriate flow regime that will protect and enhance the aquatic resources below the Wilder, Bellows Falls, and Vernon projects. Specifically, the objective of this study is to conduct an instream flow habitat study to assess the impacts of the range of proposed project discharges on the wetted area and optimal habitat for key species.

The study should include non-steady flow approaches to assess effects of within-day flow fluctuations due to peaking power operations on target fish species and benthic invertebrate communities. Target species will include but are not limited to: American shad, fallfish, white sucker, yellow perch, smallmouth bass, walleye, and dwarf wedge mussel.

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish and their habitats are important public resources. There is a strong public interest in protecting and conserving fish and their habitats. This study will determine an appropriate flow regime that will protect and enhance the aquatic resources below the Wilder, Bellows Falls, and Vernon projects. Specifically, the objective of this study is to conduct an instream flow habitat study to assess the impacts of the range of proposed project discharges on the wetted area and optimal habitat for key species, including but are not limited to: American shad, fallfish, white sucker, yellow perch, smallmouth bass, walleye, and dwarf wedge mussel.

Existing Information

The distance from the upstream end of the Wilder impoundment downstream to the Vernon dam is 120 miles. A total of 97 miles (81%) of this segment is impounded. The remaining riverine habitat is within the 17 miles downstream of Wilder dam and the 6 miles downstream of Bellows Falls. At the scoping meetings, FirstLight also indicated that their project assessment may provide evidence that the upstream extent of the Turners Falls impoundment may not reach all the way to Vernon Dam. This would suggest that there may be additional riverine habitat for a presently unknown distance below the Vernon project.

The Wilder, Bellows Falls, and Vernon projects are each operated as daily peaking facilities. Total hydraulic capacity of each facility is 12,700, 11,010, and 12,634 cfs, respectively. Each of the PADs for these projects indicate that "Generation can vary during the course of any day between the required minimum flow and full capacity if higher flows are available" (p. 2-28, p. 2-29, and p. 2-30 in the Wilder, Bellows Falls and Vernon PADs, respectively). Regular daily fluctuations on the order of 9,000 cfs or greater are commonly recorded at USGS gages 01144500 (Connecticut River at West Lebanon, below

Wilder Dam) and 01154500 (Connecticut River at North Walpole, NH, below Bellows Falls Dam). Required minimum flows are 675, 1,083, and 1,250 cfs (or inflows if less) for each facility, respectively, though in practice minimum flows are operated as 700, 1300, and 1600 cfs, respectively. The PADs for these projects do not indicate how these minimum flow requirements were established or what specific ecological resources they are intended to benefit. We are not aware of any previously conducted studies that have evaluated the adequacy of this minimum flow in protecting aquatic resources in the 23+ miles of riverine habitat below these projects, nor project effects of daily hydropeaking on riverine habitat. Therefore, in order to fill this important information gap, an empirical study is needed to provide information on the relationship between flow and habitat in the Connecticut River downstream of the Wilder, Bellows Falls, and Vernon projects. Results will be used to determine an appropriate flow recommendation.

Project Nexus

The Wilder, Bellows Falls, and Vernon projects are currently operated with a minimum flow release that was not based on biological criteria or field study. Further, the projects generate power in a peaking mode resulting in substantial within-day flow fluctuations between the minimum and project capacity. The large and rapid changes in flow releases from peaking hydropower dams are known to cause adverse effects on downstream habitat and biota (Cushman 1985, Blinn et al. 1995, Freeman et al. 2001). There are at least 23 miles of lotic (flowing) habitat below the project's discharge that are impacted by peaking operations from these projects. This section of the Connecticut River contains habitat that supports native riverine species, including the federally endangered dwarf wedge mussel, and could include spawning and rearing habitat for migratory fish such as American shad. While the existing licenses of the Wilder, Bellows Falls, and Vernon projects do require a continuous minimum flow of 675, 1,083, and 1,250 cfs, respectively, we do not believe this flow sufficiently protects the aquatic resources, including endangered species, of these river reaches, especially in the context of the magnitude, frequency, and duration of changes in habitat that likely occur due to hydropeaking operations.

Results of the flow study will be used to determine an appropriate flow recommendation that will protect and/or enhance the aquatic resources below the Project.

Proposed Methodology

In-stream flow habitat assessments are commonly employed in developing operational flow regimes that will reduce the impacts or enhance habitat conditions downstream of hydroelectric projects.

We request a flow study be conducted in the following areas: in the approximately 17 miles between the Wilder Dam and the headwaters of the Bellows Falls pool, in the approximately 6 miles between the Bellows Falls Dam and the headwaters of the Vernon pool, and in the approximately 1.5 miles between Vernon Dam and the downstream end of Stebbins Island (or the upstream extent of the Turners Pool as determined by FirstLight, whichever river length is greater).

Given the length of river reach (23+ miles) impacted by project operations, we believe a study methodology that utilizes an IFIM approach is appropriate for this context. Similar protocols have been used and accepted by FERC in numerous other licensing proceedings.

The study design should involve collecting wetted perimeter, depth, velocity, and substrate data along transects in the deep, straight-channel areas of the specified river reaches mentioned above. Two-dimensional hydraulic modeling should be conducted in the sections of river with more complex features such as islands, braiding, falls, and shallow-water shoals. The measurements should be taken over a range of flows sufficient to model the full extent of the operational flow regime. This information should then be synthesized to quantify habitat suitability (using mutually agreed-upon habitat suitability index (HSI) curves) over a range of flows for target species identified by the fisheries agencies. Data should be collected in such a way that allows a dual-flow analysis and habitat time series or similar approaches that will permit assessment of how quality and location of habitat for target species changes over the range of flows that occur as part of the operational flow regime.

Level of Effort and Cost

Field work for instream flow studies can be reasonably extensive but will depend on consultation with the applicant on study methodology and on-site decisions on locations for data collection and the number of collection locations. Use of laser measurements, GPS, and/or an Acoustic Doppler Current Profiler (ADCP, if available) can improve efficiency and accuracy of field measurements. Post-fieldwork data analysis would be a moderate cost and effort. We anticipate that the level of effort and costs will be comparable to that of other FERC relicensing projects of similar size to these projects.

Literature Cited

Blinn, W., J.P. Shannon, L.E. Stevens, and J.P. Carder. 1995. Consequences of fluctuating discharge for lotic communities. Journal of the North American Benthological Society 14: 233–248.

Cushman, R.M. 1985. Review of ecological effects of rapidly varying flows downstream from hydroelectric facilities. North American Journal of Fisheries Management 5: 330–339.

Freeman, M.C, Z.H. Bowen, K.D. Bovee, and E.R. Irwin. 2001. Flow and habitat effects on juvenile fish abundance in natural and altered flow regimes. Ecological Applications 11: 179–190.

Study Request 15. Determine the Fish Assemblage in Vernon, Bellows Falls and Wilder Project-Affected Areas

Goals and Objectives

The goal of this study request is to determine the occurrence, distribution, and relative abundance of fish species present in the project-affected areas of the Vernon, Bellows Falls and Wilder Projects, which potentially includes Species of Greatest Conservation Need (SGCN) for both New Hampshire and Vermont.

Specific objectives include:

1) Document fish species occurrence, distribution and abundance within the project-affected areas along spatial and temporal gradients.

2) Compare historical records of fish species occurrence in the project-affected areas to results of this study.

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish and their habitats are important public resources. There is a strong public interest in protecting and conserving fish and their habitats. Determining species occurrence, distribution and abundance will help address research and monitoring needs for species whose populations are poorly known. This study will provide a comprehensive investigation that documents which fish species are utilizing the project-affected areas in relation to spatial, temporal and environmental gradients (i.e. temperature, dissolved oxygen, pH, turbidity) will allow for a fuller understanding and examination of potential impacts that the Vernon, Bellows Falls and Wilder Project's operations have on the species that reside there. As noted below, there is little information concerning riverine fish in the project-affected areas as related to this study request.

Existing Information

A thorough and comprehensive assessment of the fish assemblage present in the project-affected areas of the Bellows Falls and Wilder Projects is lacking. The PAD for the Bellows Falls Project acknowledges that, "Little comprehensive information is available regarding characterization of the fish community in relation to the Project." The PAD for the Wilder Project states, "No targeted studies have been conducted to characterize the fish community in relation to the Project."

The most relevant fish study related to the Bellows Falls and Wilder project-affected areas is a Connecticut River electrofishing survey conducted in 2008 (Yoder et al., 2009). While some sampling was conducted in both project-affected areas during the 2008 survey, this survey did not have the same goals and objectives as those outlined above. Additionally, both the Bellows Falls and Wilder PADs acknowledged that fish species assemblage data are limited and that the synthesized data may not be a full representation of species occurrence in the project-affected areas. Although, fish data has been collected by Vermont Yankee for many years in the Vernon Dam project-affected area, objectives and methodology for those fish surveys differ from those stated here, and gear types were generally limited to boat electrofishing which may not be suitable for properly assessing all species present in the project-affected areas. It is unknown if other species may inhabit or utilize aquatic habitats in the projects area that to this date have not been documented by previous surveys. It follows that without more information on the fish community in the project-affected areas, project impacts on fish species are also unknown.

Project Nexus

Project operations have the potential to directly impact fish species life history requirements, biological interactions, and habitat quantity and quality. For example, headpond and tailwater water level fluctuations could dewater important spawning areas or change available habitat, thus limiting productivity of important game fish species by direct impacts to their spawning success or indirectly by limiting the spawning success of forage fish species. Furthermore, several of New Hampshire and Vermont's SGCN have been documented in the project-affected area. Accordingly, a thorough understanding of the current fish assemblage structure and associated metrics are needed in order to examine any potential project-related impacts.

Proposed Methodology

An accepted and robust field sampling design (e.g., as described in Pollock et al. 2002 or MacKenzie et al. 2006) and accepted methods for collecting fish species likely to be present in the project-affected areas (Bonar et al. 2009) should be used to conduct field surveys. Randomly sampling multiple habitat types using a multi-gear approach will be required to ensure that all fish species present are sampled. The spatial scope of the study will be from the most upstream area influenced by the Wilder Dam to the most downstream area influenced by the Vernon Project. Sampling should occur at each selected site across multiple seasons (spring, summer, and fall). Digital photographs should be taken to avoid misidentifying certain species such as Cyprinids.

The sampling design should include replicate samples for estimation of species detection probability. Sample replicates may be gathered temporally, using different methods, by independent observers, or by randomly sampled spatial replicates (MacKenzie et al. 2006). For each replicate sample, data that may be important for describing variation in species occurrence and presence/absence should be collected and recorded, such as gear type, mesohabitat type, depth, velocity, flow, water temperature, substrate, time of day, day of year, presence of cover, proportion of vegetation cover, size of individuals collected (juveniles may select different habitat), and other factors as determined by a qualified biologist. Species detection, occurrence, and/or abundance as related to these parameters should be estimated using methods as described by Kery et al. (2005), MacKenzie et al. (2006), Wenger and Freeman (2008), or Zipkin et al. (2010).

Based on first year study results, specific studies examining impacts of project operations on specific fish species may be requested. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

Level of Effort and Cost

The cost of the study will be moderate to high as seasonal sampling with several types of gear will be required. However, cost will also be partially dependent on the number of sites sampled, the number of sample replicates, and the extent of the covariate data that are measured. Provided the collected data are of high quality, analysis and synthesis should take approximately 10-20 days. TransCanada did not propose any studies specifically addressing this issue

Literature Cited:

Bonar, S.A., W.A Hubert, and D.W. Willis, editors. 2009. Standard methods for sampling North American freshwater fishes. American Fisheries Society, Bethesda,Maryland.

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department. Waterbury, Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm. (Accessed September 10, 2012).

Kery, M., J.A. Royle, and H. Schmid. 2005. Modeling avian abundance from replicated counts using binomial mixture models. Ecological Applications 15:1450-1461.

MacKenzie, D.I., J.D. Nichols, J.A. Royle, K.H. Pollock, L.L. Bailey, and J.E. Hines. 2006. Occupancy estimation and modeling: inferring patterns and dynamics of species occurrence. Elsevier: San Diego, California.

Pollock, K.H., J.D. Nichols, T.R. Simons, G.L. Farnsworth, L.L. Bailey, and J.R. Sauer. 2002. Large scale wildlife monitoring studies: statistical methods for design and analysis. Environmetrics 13:105-119.

Wenger, S.J., and M.C. Freeman. 2008. Estimating species occurrence, abundance, and detection probability using zero-inflated distributions. Ecology 89:2953-2959.

Yoder, C.O., L.E. Hersha, and B. Appel. 2009. Fish assemblage and habitat assessment of the Upper Connecticut River: preliminary results and data presentation. Final Project Report to: U.S. EPA, Region 1, Boston, MA. Center for Applied Bioassessment & Biocriteria. Midwest Biodiversity Institute. Columbus, OH.

Zimmerman, J.K.H. 2006. Response of physical processes and ecological targets to altered hydrology in the Connecticut River basin. The Nature Conservancy, Connecticut River Program, Northampton, MA.

Zipkin, E.F., J.A. Royle, D.K. Dawson, and S. Bates. 2010. Multi-species occurrence models to evaluate the effects of conservation and management actions. Biological Conservation 134:479-484.

Study Request 16. Impacts of Water Level Fluctuations on Aquatic Vegetation, Including Invasive Species, in the Vernon, Bellows Falls and Wilder Project Impoundments and Riverine Reaches

Goals and Objectives

The goal of this study is to determine if the full range of water level fluctuations from the Vernon, Bellows Falls and Wilder Hydroelectric Projects negatively impact emergent aquatic vegetation (EAV) and submerged aquatic vegetation (SAV) and their habitats in the impoundments and riverine reaches below the dams.

The objective is to conduct field studies in mainstem littoral zones, tributaries and backwaters to determine if EAV and SAV species distribution and abundance, and their habitats, are impacted by current water level fluctuations permitted under the TransCanada Projects' licenses and whether aquatic vegetation and its habitats can be enhanced by modifications to project operations or other mitigation measures and whether there is any unique or important shoreline or aquatic habitats that should be protected. Results of this study may also be used to help determine the adequacy of existing downstream minimum flow requirements.

The specific objectives of the field study, at a minimum, include:

- Quantitatively describe and map wetland types within 200 feet of the shoreline, and describe associated wildlife;
- Delineate, quantitatively describe, and map all wetland types including invasive species and wildlife observed (e.g., bald eagle nesting, water fowl nesting) within 200 feet of the shoreline, and the extent of this habitat if it extends beyond 200 feet; and
- Quantitatively describe (e.g., substrate composition, vegetation type and abundance) and map shallow water aquatic habitat types subject to project operation inundation and exposure, noting and describing additional areas where water depths at lowest operational range are wetted to a depth less than one foot (flats, near shore areas, gravel bars, with very slight bathymetric change);

A second year of study may be required should river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

The field study should produce a habitat inventory report that includes:

- The results of the field study in the form of maps and descriptions;
- An assessment of project effects on wetland, riparian, littoral zone vegetation and shallow water habitats, invasive plant species, and wildlife habitat at the project; and
- Recommendations for any necessary plant, habitat type, or wildlife, protection and/or invasive species control measures.

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

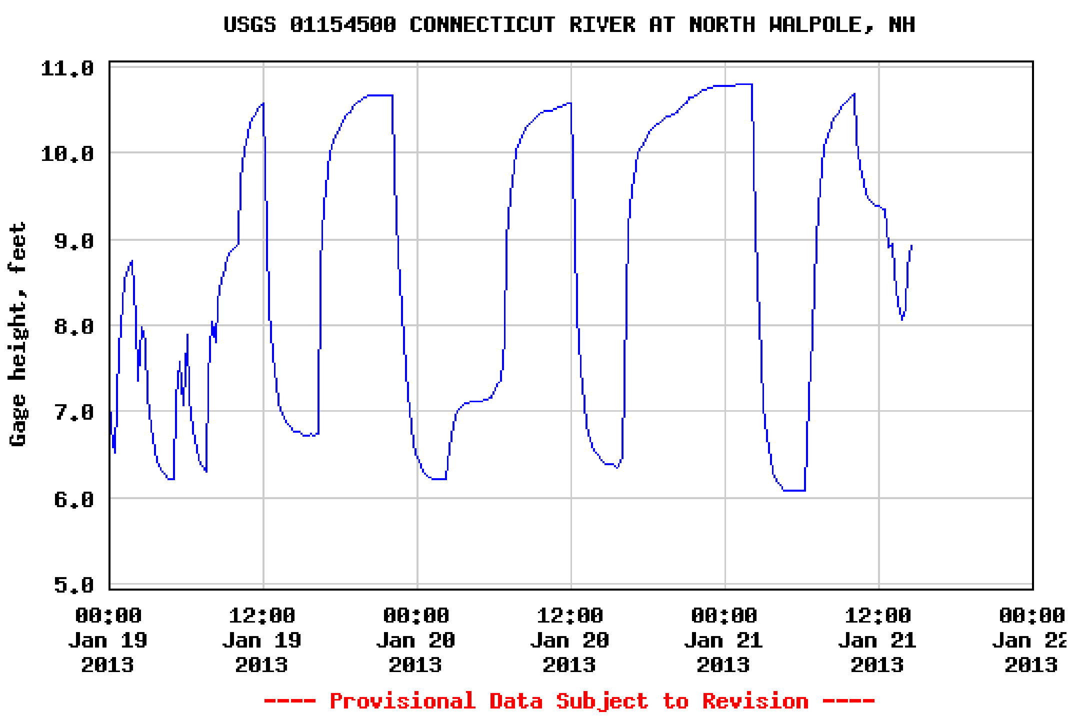
Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish, wildlife, plants, and their habitats are important public resources. There is a strong public interest in protecting, conserving, and enhancing these resources for public benefit, including wetlands, endangered species, and migratory species. Riverine fish species are an important component of the river's ecology and in some cases are the basis for a sport fishery. Aquatic vegetation is crucial fish habitat as the majority of fish in the project impoundments utilize emergent aquatic vegetation and submerged aquatic vegetation at some point during their life history. This study will determine if the full range of water level fluctuations from the Vernon, Bellows Falls and Wilder Hydroelectric Projects negatively impact emergent aquatic vegetation and submerged aquatic vegetation and their habitats in the impoundments and riverine reaches below the dams.

Existing Information

Existing information in the PADs does not quantify EAV and SAV. However, the applicant acknowledges that water level fluctuations caused by the project have the potential to affect fringing wetland and littoral areas:

> "*The average daily water level fluctuation of 2.5 vertical feet has resulted in a zone of sparse vegetation along most of the shorelines of the impoundment. Wetland and littoral resources in this zone are limited by the frequent wetting and drying.*" (Wilder PAD, p.3-104, see also similar language in the Bellows Falls PAD p. 3-115 and the Vernon PAD p. 3-143)

An example of the water level fluctuations that occur in the Lower Connecticut River due to hydropower generation is shown below.



Project Nexus

Water level fluctuations due to project operations have the potential to influence fish species life history requirements, biological interactions, and habitat quantity and quality by impacting EAV and SAV. For example, water level changes due to project operations could create conditions where EAV and SAV abundance is diminished, thus negatively impacting a habitat used by riverine fish for spawning, rearing, feeding, and cover. Additionally, water level fluctuations due to project operations could influence EAV and SAV habitat in the project impoundments and promote invasive plants over native species. This study needs to take into account existing and potential future limits on impoundment level fluctuations intended to limit recreation impacts, and the interactions of any changes in pond level fluctuation range or frequency and discharge changes.

Proposed Methodology

Vegetation mapping and mapping of littoral zones in relation to water level fluctuations are common tools for identifying EAV and SAV that may be impacted by changes in water levels. The study should include field surveys designed to describe the characteristics of each mapped wetland, riparian, littoral and shallow water habitat including plant species composition, relative abundance/density, habitat quality, and land use. These surveys should be conducted to describe these habitats at the lowest water level operational range permitted on a daily operation schedule, under low flow conditions. Information collected should include:

- Plant species composition, and their relative abundance/density and condition/structure (e.g., seedlings)
- Surveying for the federally Endangered Northeastern bulrush (*Scirpus ancistrochaetus*);
- Structured data, including estimates of average heights and aerial cover of each vegetation layer (specifically denoting invasive species);
- Aquatic habitat substrate composition, quantity (i.e., percent types and area), wood structure (relative abundance measure applied by area), water depths (inundated, exposed, and water less than one foot);
- Predominate land use(s) associated with each cover type;
- Wildlife sightings should be noted;
- Field verified wetland, riparian, and littoral and shallow water habitats and invasive species occurrences, should be geo-referenced as polygons and overlain on orthophoto at a suitable scale.
- Identification (mapped location, total area) of any EAV, SAV or other fish habitat (i.e. wood, rocks, etc) that is dewatered at the lowest water level operational range permitted on a daily operation schedule, under low flow conditions.

Bathymetric mapping of the littoral zone will be needed to model the extent of this zone that will be affected by different water fluctuation scenarios.

The study area is from the most upstream area influenced by the Wilder Dam to the most downstream area influenced by the Vernon Dam. Water level fluctuations caused by the projects may affect not only the impoundments, but also the downstream river reaches below the dams. Studies would occur in the main river littoral zone and in backwater areas during spring, summer and fall. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

Level of Effort and Cost

Although the PAD's acknowledge that project operations have the potential to impact littoral resources, TransCanada did not propose any studies concerning aquatic vegetation. Analysis as described above is needed to understand potential impacts of the projects on these resources. Estimated cost for the study is moderate due to the need for field assessment.

Study Request 17. Impacts of the Vernon, Bellows Falls and Wilder Project Impoundment Water Fluctuations on Resident Fish Spawning

Goals and Objectives

The goal of this study is to determine if the full range of water level fluctuations in the Vernon, Bellows Falls and Wilder Hydroelectric Projects negatively impact resident fish species (smallmouth bass, largemouth bass, yellow perch, black crappie, common sunfish, bluegill, chain pickerel, northern pike, golden shiner, common white sucker, spottail shiner, walleye and fallfish) in the impoundments, and if impacts are found to occur, to develop appropriate mitigation measures.

Specific objectives include:

1) Conduct field studies in the mainstem, tributaries and backwaters of project affected areas to assess timing and location of fish spawning. Nesting locations should be mapped.

2) Conduct field studies in the mainstem, tributaries and backwaters of project-affected areas to evaluate potential impacts of impoundment fluctuation on spawning habitat, nest abandonment, spawning fish displacement and egg dewatering. The study should also evaluate if changes in impoundment fluctuation range would mitigate for identified impacts and if other mitigative measures would lessen these impacts.

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

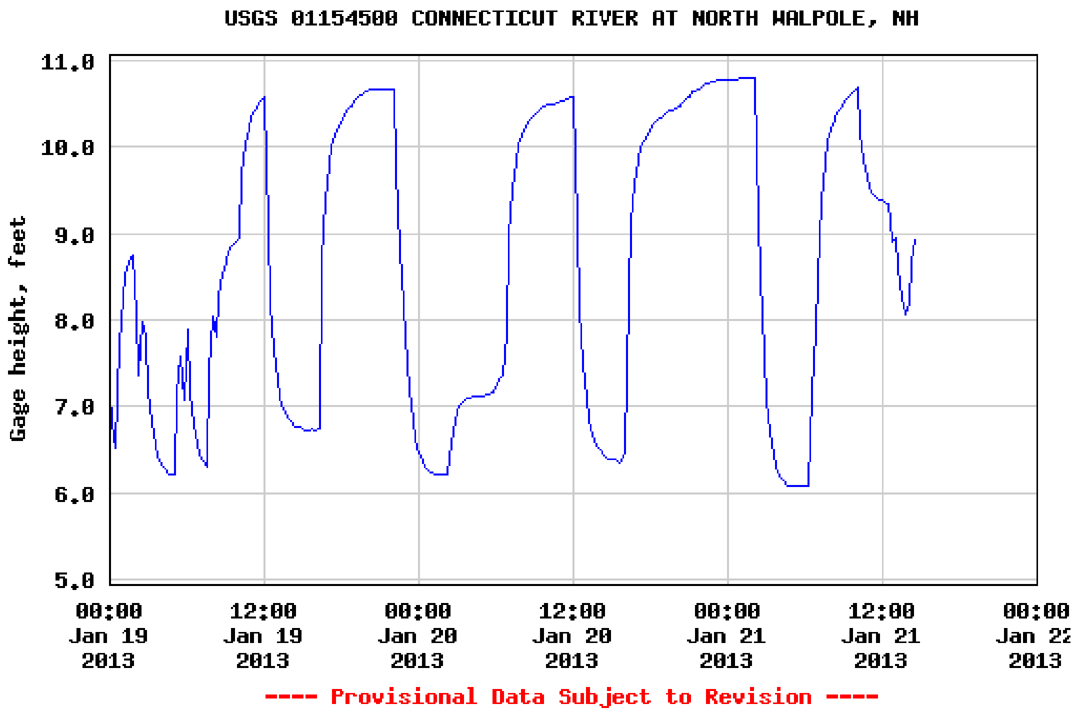
Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish, wildlife, plants, and their habitats are important public resources. There is a strong public interest in protecting, conserving, and enhancing these resources for public benefit, including wetlands, endangered species, and migratory species. This study will determine if the full range of water level fluctuations in the Vernon, Bellows Falls and Wilder Hydroelectric Projects negatively impact resident fish species (smallmouth bass, largemouth bass, yellow perch, black crappie, common sunfish, bluegill, chain pickerel, northern pike, golden shiner, common white sucker, spottail shiner, walleye and fallfish) in the impoundments, and if impacts are found to occur, to develop appropriate mitigation measures.

Existing Information

To our knowledge, no information exists related to this requested study.

An example of the water level fluctuations that occur in the Lower Connecticut River due to hydropower generation is shown below.



Project Nexus

Project operations have the potential to impact fish species by influencing spawning success and spawning habitat quality and quantity. For example, water level changes due to project operations could create conditions where fish eggs are exposed to air, where quality spawning habitat is dewatered, and/or where fish abandon nests containing eggs. The New Hampshire Fish and Game Department has received several calls in past springs regarding "acres" of yellow perch eggs being dewatered in the Bellows Falls Impoundment.

The projects operate within normal, permitted and flood-condition reservoir fluctuation limits that include during high flow events, the dropping of stantion bays that cannot be raised without a subsequent drawdown of the impoundment beyond normal project operating ranges. The full range of reservoir fluctuations, including periodic drawdowns for stantion bay replacement, need to be addressed in this study.

Proposed Methodology

Common tools to evaluate fish spawning and habitat would be used including, but not limited, electrofishing, visual observations, telemetry and habitat measurements. The study area for this request includes all impounded waters, including tributaries and backwaters, within the project-affected areas of the Vernon, Bellows Falls and Wilder Hydroelectric Projects. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

Level of Effort and Cost

TransCanada does not propose any studies to meet this need. Estimated cost for the study is moderate to high but is dependent on the amount of field study that is needed.

Study Request 18. Impacts of Water Fluctuations Downstream of the Vernon, Bellows Falls and Wilder Projects on Resident Fish Spawning

Goals and Objectives

The goal of this study is to determine if the full range of project induced flow and water level fluctuations in the project-affected areas below the Vernon, Bellows Falls and Wilder Dams negatively impact resident fish spawning (smallmouth bass, common white sucker, walleye and fallfish), and if impacts are found to occur, to develop appropriate mitigation measures.

Specific objectives include:

1) Conduct field studies in the project-affected areas downstream from the Vernon, Bellows Falls and Wilder Dams to assess timing and location of fish spawning. Nesting locations should be mapped.

2) Conduct field studies in the Project affected areas below the Vernon, Bellows Falls and Wilder Dams to evaluate potential impacts of the full range of project induced water level fluctuations on nest abandonment, spawning fish displacement and egg dewatering. The study should also evaluate if changes in fluctuation range would mitigate for identified impacts and/or if other mitigative measures would lessen these impacts.

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish, wildlife, plants, and their habitats are important public resources. There is a strong public interest in protecting, conserving, and enhancing these resources for public benefit, including wetlands, endangered species, and migratory species. This study will determine if the full range of project induced flow and water level fluctuations in the project-affected areas below the Vernon, Bellows Falls and Wilder Dams negatively impact resident fish spawning (smallmouth bass, common white sucker, walleye and fallfish), and if impacts are found to occur, to develop appropriate mitigation measures.

Existing Information

To our knowledge, no information exists related to this requested study.

Project Nexus

Project operations have the potential to impact fish species by influencing spawning success and spawning habitat quality and quantity. For example, flow and water level changes due to Project operations could create conditions where fish eggs are exposed to air, where quality spawning habitat is dewatered, and/or where fish abandon nests containing eggs. A study of a regulated river found temporal fluctuations of streamflow appeared to be the most important abiotic factor determining smallmouth bass nesting success or failure (Lukas and Orth 1995). Similarly, other research suggests stream discharge during and immediately after spawning could be important to smallmouth bass recruitment success (Smith et al. 2005). Current can also impact early survival of walleye by moving eggs and larvae from spawning sites (Humphrey et al. 2012).

Proposed Methodology

Common tools to evaluate fish spawning would be used including electrofishing, visual observations, and telemetry. Specific areas of interest are locations in project-affected areas below the Vernon, Bellows Falls and Wilder Dams where it is determined that the before mentioned fish species spawn. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

Level of Effort and Cost

TransCanada does not propose any studies to meet this need. Estimated cost for the study is moderate.

Literature Cited:

Humphrey, S, Y.M. Zhao and D. Higgs. 2012. The effects of water currents on walleye (Sander vitreus) eggs and larvae and implications for the early survival of walleye in Lake Erie. Canadian Journal of Fisheries and Aquatic Sciences 69: 1959-1967.

Lukas, J.A. and D.J. Orth. 1995. Factors affecting nesting success of smallmouth bass in a regulated Virginia stream. Transactions of the American Fisheries Society 124: 726-735.

Smith, S.M., J.S. Odenkirk, and S.J. Reeser. 2005. Smallmouth bass recruitment variability and its relation to stream discharge in three Virginia rivers. North American Journal of Fisheries Management 25: 1112-1121.

Study Request 19. Impacts of the Vernon, Bellows Falls and Wilder Project Operations on Tributary and Backwater Area Access and Habitats

Goals and Objectives

One goal of this study is to determine if water level fluctuations from the Vernon, Bellows Falls and Wilder Hydroelectric Projects result in a barrier(s) to fish movement in and out of tributaries and backwaters to the impoundments and riverine reaches below dams.

A second goal is to determine if water level fluctuations in the Vernon, Bellows Falls and Wilder Project impoundments impact water levels, available fish habitat and water quality in tributaries and backwaters to the impoundments and riverine reaches below dams, and if impacts are found, to ascertain how spatially far reaching they are and develop mitigation measures.

Results of this study may also be used to help determine the adequacy of existing downstream minimum flow requirements.

Specific objectives include:

1) Conduct a field study of tributaries and backwaters, including water velocity and habitat data where appropriate, to evaluate potential impacts of impoundment fluctuation on fish access to tributaries and backwater areas. The study should also evaluate if changes in impoundment fluctuation range would mitigate for any identified impacts and if other mitigative measures would improve access.

2) Conduct a field study to examine potential impacts of impoundment fluctuations on water levels, available habitat and water quality in tributaries and backwaters. The evaluation should also evaluate if changes in impoundment fluctuation range would mitigate for identified impacts and if other mitigative measures would lessen these impacts.

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

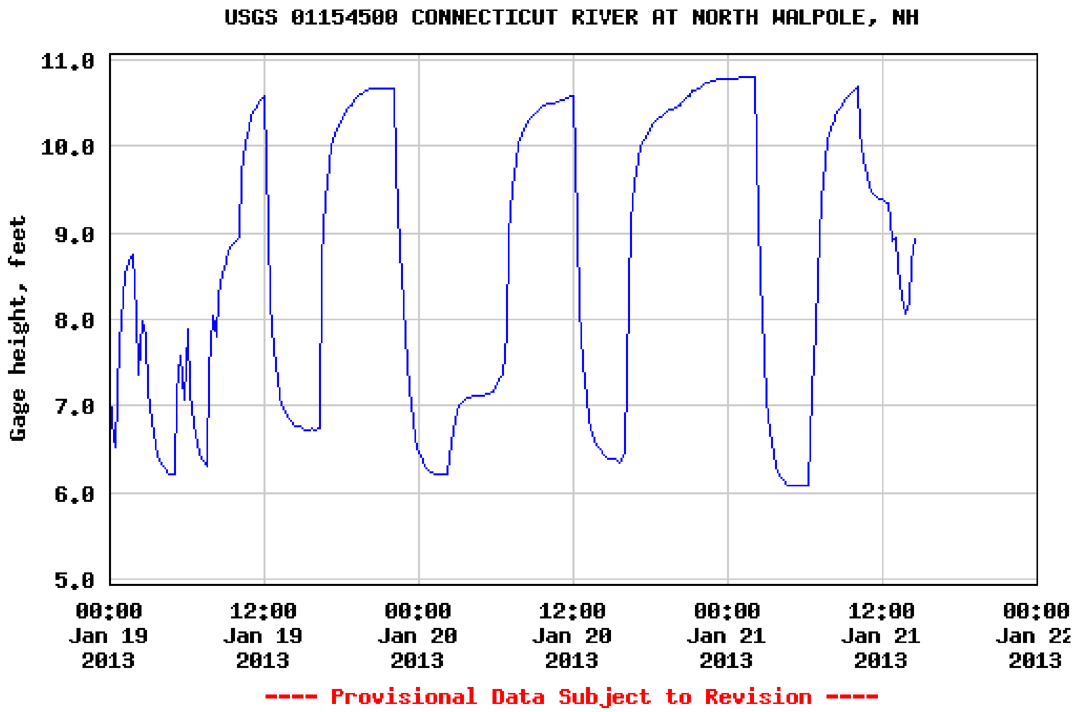
Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish, wildlife, plants, and their habitats are important public resources. There is a strong public interest in protecting, conserving, and enhancing these resources for public benefit, including wetlands, endangered species, and migratory species. This study will determine if water level fluctuations from the Vernon, Bellows Falls and Wilder Hydroelectric Projects result in a barrier(s) to fish movement in and out of tributaries and backwaters to the impoundments and riverine reaches below dams. This study will also help promote tributary and backwater access and protect valuable fish habitat and maintain appropriate water quality conditions for diadromous and riverine fish species in project-affected areas. Maintaining connectivity between the mainstem of the Connecticut River and tributaries and backwaters is vital to the fish populations in these systems, as many fish species utilize these areas for spawning, rearing, refuge, and feeding.

Existing Information

To our knowledge, no information exists related to this requested study.

An example of the water level fluctuations that occur in the Lower Connecticut River due to hydropower generation is shown below.



Project Nexus

Project operations have the potential to impact fish species life history requirements, biological interactions, and habitat quantity and quality. For example, water level changes due to project operations could create conditions that could impede free movement of fish between tributaries/backwaters and the mainstem of the Connecticut River, thus limiting access to spawning habitat and/or growth opportunities. Additionally, water level changes could also alter tributary and backwater fish habitat quality, quantity, and also water quality, thus decreasing productivity and available habitat. Furthermore, two of New Hampshire and Vermont's SGCN that could be impacted have been documented in the project-affected areas.

Proposed Methodology

Common tools to evaluate water level impacts would be used including: bathymetric mapping, substrate, depth and velocity measurements, and water quality information (dissolved oxygen, temperature, turbidity, and pH). Studies should be conducted throughout the year.

The study area for tributary and backwater fish sampling should cover all tributaries and backwaters within the project-affected areas of the Vernon, Bellows Falls and Wilder Hydroelectric Projects. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

Level of Effort and Cost

TransCanada does not propose any studies to meet this need. Estimated cost for the study is relatively low.

Study Request 20. Determine Upstream Passage Needs for Riverine Fish Species in the Bellows Falls, Wilder and Vernon Fishways

Goals and Objectives

The goal of this study is to determine the adequacy of the existing Bellows Falls, Wilder, and Vernon fish ladders in passing riverine species and determine the appropriate operation period for these fishways to pass riverine and diadromous fish.

Specific objectives include:

- Identify the utilization and temporal distribution, of passage through the Bellows Falls, Wilder, and Vernon fishways by riverine and diadromous fish species
- Review existing Vermont Fish and Wildlife Department's (VTFWD) fish passage data to increase sample size and gain a better understanding of temporal variability.
- Operate and monitor the fishways year-round (or until otherwise infeasible) to assess fishway use over a longer period than the fishways have traditionally been operated to:
    1. Determine the appropriate operating windows of the fishways for riverine species
    2. Determine the appropriate operating windows of the fishways for diadromous species such as American eel and sea lamprey.

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish, wildlife, plants, and their habitats are important public resources. There is a strong public interest in protecting, conserving, and enhancing these resources for public benefit, including wetlands, endangered species, and migratory species. Connectivity within a river system is important for healthy fish populations. By allowing fish to move through the fishway during different times of the year, and during different life history stages, access to available riverine aquatic habitat is increased. Fish are able to seek the best available habitat and food resources, as well as avoid predator interactions. Furthermore, movement within a river system promotes genetic diversity. This study will assess the adequacy of the existing Bellows Falls, Wilder, and Vernon fish ladders in passing riverine species and determine the appropriate operation period for these fishways to pass riverine and diadromous fish. Currently upstream resident fish passage at the Bellows Falls, Wilder, and Vernon dams is precluded most of the year due to fishway closure.

Existing Information

No such information exists that will allow for a comprehensive assessment of existing year round fishway utilization by resident species. The VTFWD has several years (2007-2012) of seasonal passage data that have not yet been analyzed. These data are in the form of .avi files, but only include the spring and summer months (typically May- July).

The PAD acknowledges that "Resident species have also been recorded using the Bellows Falls and Wilder fish ladder". Those data are available from the Vermont Fish & Wildlife Department. Fish passage video data that have been processed should be available for distribution in the future (Lael Will, Vermont Fish & Wildlife, personal communication)". Although not comprehensive, analysis of these data would assist in filling this data gap.

In 2012, VTFWD staff documented resident species passage at the Vernon fishway. Species observed utilizing the fishway included bluegill (N = 555), common carp (N = 209), channel catfish (N = 37), trout sp. (N = 2), walleye (N = 54), white sucker (N = 102), and American eel (N =262). However, these analyses were conducted during one year and did not include any monitoring outside of the spring spawning run.

Project Nexus

The Bellows Falls, Wilder and Vernon dams span across the Connecticut River, acting as a physical impediment to fish passage. Therefore, the project has a direct impact on fish passage and limits fish from accessing available aquatic habitat located upstream of the dam.

The PAD acknowledges that "river fragmentation can reduce or obstruct fish and aquatic community connectivity and therefore genetic diversity and stock structure. However, those impacts are reduced by the provision of fish passage and the length of the impoundment. Upstream and downstream fish passages, designed for Atlantic salmon, are likely used by other migratory and resident species, providing connectivity; however, fish counts are limited, unknown or unavailable for resident species". In fact, it is known that riverine and diadromous species use the fishways, but there has been limited analysis of this data and fishway monitoring was limited to spring period.

Therefore, in order to determine the level of riverine fish passage through the existing fishways, and the appropriate operation period for the fishway , review of existing data and , further monitoring of the fishways is warranted.

Proposed Methodology

Fishway monitoring has been conducted annually by VTFWD dating back to 1985. Monitoring was focused on Atlantic salmon, American shad and American eel. Resident species were recorded periodically, but were not monitored outside the spring anadromous fish migration period

Fishway monitoring has been used to assess existing and proposed project operations, and to develop appropriate operating windows for fisheries resources.

In addition to fish window count data, monitoring should include monitoring of the hydraulic conditions in the fishways and fishway entrances, and periodic fish observations should be made over the length of the fishways. If count data or observations of the fishways indicate the need for fishway operation changes or for more specific information on fish movement through the fishways, changes to the monitoring plan for year 2 monitoring would need to be implemented.

Level of Effort and Cost

This study will require video monitoring equipment, appropriate software (e.g. salmon soft), and personal to read to files, and manage the equipment. Some information already exists in the form of .avi files and past count data and are readily available from VTFWD. No other tool (e.g. radio telemetry) is more appropriate or cost effective for these types of assessments. Cost is relatively low.

Study Request 21. Shad Population Model for the Connecticut River

Develop an American shad annual step, mathematical simulation population model for the Connecticut River to quantify how project operations and potential restoration/mitigation measures impact the population of shad in the Connecticut River.

Goals and Objectives

The goal of the model is to assess impacts of both upstream and downstream passage at each of the Connecticut River projects and potential management options for increasing returns to the river.

Specific objectives include:

- Annual projections of returns to the Connecticut River;
- A deterministic and stochastic option for model runs
- Life history inputs of Connecticut River shad
- Understanding the effect of upstream and downstream passage delay at projects
- Calibration of the model with existing data
- Analysis of the sensitivity of model inputs
- Analysis of sensitivity to different levels of up- and downstream passage efficiencies at all projects
- Multiple output formats including a spreadsheet with yearly outputs for each input and output parameter

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish and their habitats are important public resources. There is a strong public interest in protecting and conserving fish and their habitats. This study will quantify how project operations and potential restoration/mitigation measures impact the population of shad in the Connecticut River.

Existing Information

Since the construction of the first fish lift facility at Holyoke Dam in 1967, American shad have had access to spawning and rearing habitat upstream from Holyoke Dam. A number of improvements to the Holyoke fishway have occurred since that time, but while the numbers of shad lifted at Holyoke have reached as much as 721,764 and the overall shad population to the river exceeded 1.6 million shad in

1992 (CRASC 1992), total shad populations, and numbers of shad passing Holyoke, Turners Falls and Vernon Dam have not met CRASC management goals.

Population and passage numbers past Holyoke have declined substantially from those totals in recent years, with average Holyoke passage numbers since 2000 of 229,876. Whole river population estimates have shown that approximately half of the returning population of shad pass upstream of Holyoke. Recent returns to Holyoke are far below management goals. Average passage efficiency of shad at Turners Falls (Gatehouse counts) and Vernon since 2000 has been 3.1 and 20.4 % respectively. These too are well below the CRASC management goals.

Safe, timely and effective up- and downstream passage along with successful spawning and juvenile production are necessary to help achieve shad management goals for the Connecticut River.

Project Nexus

Existing project operations and fish ladder efficiencies have a direct effect on shad populations in the Connecticut River. Poor upstream passage efficiencies and delays restrict river access to returning shad. Fish unable to reach upriver spawning grounds may not spawn or have reduced fitness or survival of young. Poor downstream passage survival and downstream passage delays affect outmigration and consequently repeat spawning, an important ecological aspect of the iteroparous Connecticut River shad population (Limberg et al. 2003).

The Service is concerned that poor passage efficiencies and delays at projects may be limiting access to upstream reaches of the river, altering spawning behavior, decreasing outmigration survival and contributing to the failure of the Connecticut River shad population to meet management targets (Castro-Santos and Letcher 2010).

Development of a population model will allow an assessment of individual project impacts on the population as well as the cumulative impacts of multiple projects. The model will allow managers to direct their efforts in the most efficient manner toward remedying the conditions that most impact the shad population.

Proposed Methodology

Population models are commonly used to assess anthropomorphic and natural impacts and are consistent with accepted practice. A model similar to this request was constructed for the Susquehanna River by Exelon (FERC #405, RSP 3.4). The model is constructed in Microsoft Access

Specific parameters that would be included in the model:

- Upstream passage efficiency at Holyoke, Turners Falls (Cabot, Gatehouse and Spillway Ladders), Vernon fishways, and any impacts associated with Northfield Mountain.
- Distribution of shad approaching the Turners Falls project between the Cabot Ladder and the spillway at the dam
- Downstream passage efficiencies at Vernon, Northfield Mountain, Turners Falls, and Holyoke projects for juveniles and adults
- Entrainment at Mount Tom and Vermont Yankee
- Sex ratio of returning adults

- The proportion of virgin female adults returning at 4, 5, 6, and 7 years
- The proportion of repeat spawning females at 5, 6 and 7 years
- Spawning success of females in each reach
- Fecundity
- Percent egg deposition
- Fertilization success
- Larval and juvenile in-river survival
- Calibration factor to account for unknown parameters such as at sea survival
- Options for fry stocking and trucking as enhancement measures
- Start year and model run years
- Start population
- Rates of movement to and between barriers
- Temperature, river discharge, and other variable of influence to migration and other life history events

The model should be adaptable to allow the input of new data and other inputs.

Level of Effort and Cost

Neither First Light nor TransCanada have proposed any study to meet this need. Estimated cost for the study is expected to be low to moderate. As the model describes the impacts of multiple projects and two owners, both project owners would share the cost of model development.

Literature cited:

CRASC (Connecticut River Atlantic Salmon Commission). 1992. A management plan for American shad in the Connecticut River basin. Sunderland, MA

Castro-Santos, T and B. H. Letcher. 2010. Modeling migratory bioenergetics of Connecticut River American shad (*Alosa sapidissima*): implications for the conservation of an iteroparous anadromous fish. Can.J.Fish.Aquat.Sci. 67: 806-830

Limberg, K. E., K. A. Hattala, and A. Kahne. 2003. American shad in its native range. Pages 125-140 in K. E. Limberg and J. R. Waldman, editors. Biodiveristy, status and conservation of the world’s shads. American Fisheries Society, Symposium 35, Bethesda, Maryland

Study Request 22. Telemetry Study of Upstream and Downstream Migrating Adult American Shad to Assess Passage Routes, Effectiveness, Delays, and Survival

Goals and Objectives

Assess behavior, approach routes, passage success, survival, and delay by adult American shad as they encounter the projects during both upstream and downstream migrations, under permitted project operations conditions, proposed operational conditions, and study treatment operational conditions at First Light Power's Turners Falls and Northfield Mountain Pumped Storage projects and TransCanada's Vernon Project. There are multiple fishways and issues related to both upstream and downstream passage success at the projects. Some of these issues at the Turners Falls Project are similar to and/or pertain directly to the Northfield Mountain and Vernon projects. Therefore, it is reasonable to address passage issues at all projects in a similar manner.

<u>Telemetry Study -</u> This requested study requires use of radio telemetry using both radio and Passive Integrated Transponder (PIT) tag types to provide information to address multiple upstream and downstream fish passage issues. The following objectives shall be addressed in these studies:

- Assessment of any migration delays resulting from the presence of the dam and peaking flow operations of the Turners Falls Project;
- Determine route selection and behavior of upstream migrating shad at the Turners Falls Project under various spill flow levels (e.g., movement to the dam, attraction to Cabot Station, attraction to Station 1 discharge, movement between locations, delay, timing, etc.). A plan and schedule for dam spill flow releases will need to be developed that provides sufficient periods of spill flow conditions, and various generating levels from Turners #1 Station coupled with Cabot Station generation flows (e.g., treatments will require multiple days of consistent discharge). Evaluated spill flows should include flows between 2,500 – 6,300 cfs, which relate to bypass flows identified as providing spawning opportunities for shortnose sturgeon in the lower bypass reach at the Rock Dam. (Kieffer and Kynard 2012). Sturgeon spawning and upstream shad passage occur concurrently;
- Assess near field, attraction to and entrance efficiency of the Spillway Ladder by shad reaching the dam spillway, under a range of spill conditions;
- Evaluate the internal efficiency of the Turners Falls Spillway Ladder;
- Continue data collection of Cabot Station Ladder and Gatehouse Ladder efficiency, to include rates of approach to fishway entrances, entry into fishways, and passage through them, under different operational conditions that occur in these areas;
- Evaluate modifications to the Cabot and/or Spillway fishways recommended by the US Fish and Wildlife Service if they are implemented;
- Assess upstream migration from Turners Falls to the Vernon Dam in relation to Northfield Mountain's pumping and generating operations and Vernon Project peaking generation operations. Typical existing and proposed project operation alterations should be evaluated;
- Assess near field, attraction to and entrance efficiency of the Vernon Dam Ladder;

- Assess internal efficiency of the Vernon Dam Ladder;
- Assess upstream passage past Vermont Yankee's thermal discharge (also located on the west bank of the river 0.45 mile upstream of fish ladder exit)
- Assess upstream migration from Vernon Dam in relation to the peaking generation operations of the Bellows Falls Project. Typical existing and proposed project operation alterations should be evaluated;
- Determine post-spawn downstream migration route selection, passage efficiency, delays and survival related to the Vernon Project, including evaluation of the impact of the Vermont Yankee heated water discharge plume on downstream passage route, migrant delay/timing, efficiency and survival;
- Assess impacts of Northfield Mountain operations on up- and downstream adult shad migration, including delays, entrainment, and behavioral changes and migration direction shifts under existing and proposed project operations;
- Determine downstream passage route selection, timing/delay, and survival under varied project operational flows into the power canal and spill flows at Turners Falls Dam;
- Determine downstream passage route selection, timing/delay in the canal, Cabot Station fish bypass facility effectiveness, and survival of Cabot-bypassed adult shad that enter the Turners Falls Canal system;
- Compare rates and or measures of delay, movement and survival etc., among project areas or routes utilized (e.g., spill at dam vs. power canal) under the range of permitted and proposed conditions; and
- Utilize available data sets and further analyze raw data (e.g., 2003- 2012 Conte Lab Studies) where possible to address these questions and inform power analyses and experimental design.

Information to address all of these questions would rely on the tagging of upstream migrating adult shad at Holyoke Dam and releasing them to migrate naturally from Holyoke through the Turners Falls and Vernon projects and back downstream after spawning. Additional tagged individuals would likely need to be released farther upstream (Turners Falls Canal, upstream of Turners Falls Dam, and upstream of Vernon Dam), to ensure that enough tagged individuals encounter project dams on both upstream and downstream migrations, that these individuals are exposed to a sufficient range of turbine and operational conditions to test for project effects, and to provide adequate samples sizes for statistically valid data analyses to address the many objectives listed. This study will require two years of field data collection to attempt to account for inter-annual variability in river discharge and water temperatures.

<u>Evaluation of Past Study Data</u>- In addition to collection and analysis of new telemetry data, substantial data has already been collected at Turners Falls from multiple years of passage assessments conducted for First Light by U.S. Geological Survey's Conte Anadromous Fish Research Center (Conte Lab) researchers and there are also data from the 2011 and 2012 full river study conducted by the Conte Lab that address Turners Falls, Northfield Mountain and Vernon project migration and passage questions that have not yet been analyzed. These data include several million records each year from more than 30 radio telemetry receivers deployed between Middletown, CT and Vernon Dam. This data will provide substantial information free from the field data collection costs and therefore should be analyzed as part of this study. This data analysis should be completed in 2013 to help inform the design of subsequent field studies.

<u>Evaluation of Methods to Get Shad Past Cabot Station for Spillway Passage at the Turners Falls Dam</u> – The poor passage efficiency of the Cabot Ladder, the first and most used fishway encountered by shad

arriving at the Turners Falls Project, and at the entrance to the Gatehouse Ladder, which all Cabot fishway-passed fish must use, has resulted in very poor overall shad passage efficiency at the project. An alternative to passing fish at the Cabot Station is to install a fish lift at the dam that would put fish directly into the Turners Falls pool, thereby eliminating problems with the Cabot Fishways, and the Gatehouse Fishway entrance and the variable passage efficiency of the Gatehouse Fishways. For this to be effective, attraction of shad to the Cabot Station discharge and associated delays would need to be overcome. It is possible that spillway flow releases coupled with behavioral measures at Cabot Station that dissuade shad from that tailrace could achieve this end. In order to assess the possibilities, we recommend the following study:

1. A literature search and desk-top assessment of the possible behavioral measures that could be effective in getting shad to pass Cabot Station tailrace and continue upstream to the dam.
2. Based on results of the desk-top assessment, possible evaluation of behavioral measures that are likely to be effective.
3. Field evaluation of the effect of different levels of spill at the dam that would induce fish to move past the Cabot Station into the bypass reach and up to the dam (as noted in objectives).

Besides passage success and delays at passage facilities, these studies would assess the impacts of project operations on migration passage delay, route, timing, injury, mortality, and passage structure attraction, retention, and success. Of particular interest will be fish behavior during periods when flow releases from the project increase from the required minimum flows to peak generation flows and when flows subside from peak generation flows to minimum flows and the operation of NMPS in pumping and generation modes.

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish and their habitats are important public resources. There is a strong public interest in protecting and conserving fish and their habitats. This study will assess behavior, approach routes, passage success, survival, and delay by adult American shad as they encounter the projects during both upstream and downstream migrations, under permitted project operations conditions, proposed operational conditions, and study treatment operational conditions at First Light Power’s Turners Falls and Northfield Mountain Pumped Storage projects and TransCanada’s Vernon Project.

Existing Information

Passage of adult shad at the Turners Falls fishway complex has been the subject of intense study by the Conte Lab since before 1999. These studies have clearly demonstrated that passage through the existing fishways at Cabot and Spillway is poor (<10% in many years). Passage through the Gatehouse fishway is better, but still rarely exceeds 80%, despite the short length of this ladder. In addition to poor passage for fish entering the ladders, shad that ascend the Cabot Fishway experience extensive delays before entry into the Gatehouse Fishway. Shad that ascend Spillway frequently fall back into the canal and are also subject to these upstream delays. A new entrance to the Gatehouse Fishway installed in 2007 led to dramatic improvements in passage out of the canal (from 5% to over 50% in 2011), but passage still falls well short of management goals. In addition, shad spend considerable time (up to several weeks) attempting to pass. These delays likely influence spawning success and survival. Adult shad, unable to pass Gatehouse, experience similar delays in downstream passage, even after they have stopped trying to pass Gatehouse. Without spill, all outmigrating shad that have passed Gatehouse must enter the canal at the Gatehouse and may be subject to delays exiting the canal.

During the course of these studies a very large dataset has been compiled that could yield useful information for further improving passage of shad out of the canal in both the upstream and downstream directions. A unique feature of these data is a 2-dimensional array covering the canal just downstream of Gatehouse, documenting fine scale movements and occupancy of this zone. These data should be combined with computational fluid dynamics (CFD) and real-time hydraulic data to determine how canal hydraulics influence the ability of shad to locate and enter the fishway, and to identify modifications that are likely to lead to improvements in approach and entry rates. A separate CFD modeling study is requested that includes modeling of the Gatehouse Fishway entrance are at the head of the power canal.

In addition, whole-river shad telemetry studies performed in 2011 and 2012 will likely provide useful information and should be analyzed. These data should allow quantification of delay below Turners Falls, and could help guide studies requested above. Preliminary analyses of data through 2011 have been made available to FirstLight and the resource agencies (Castro-Santos and Haro 2005; Castro-Santos and Haro 2010).

The whole-river studies have also shown that, at least in 2011, most shad that pass Turners Falls rapidly progress upstream to Vernon Dam where extensive delays also occur. Data from the 2012 study were not available at this time, but Dr. Castro-Santos stated similar patterns were noted in the data between the years on the topic of upstream delay (personal communication, Dr. Theodore Castro-Santos). Similarly, concerns relative to the downstream passage of spent shad also remain relative to delays, with existing unpublished USGS telemetry data sets suggesting this is an issue within the Turners Falls canal.

Since the first year of operation of the Turners Falls upstream fishways (1980), the percent passage of American shad annually passed upstream of Turners Falls Dam compared to the number passed at the Holyoke Fish Lift has averaged 3.6% (1980-2012 data). The highest values for this metric has not exceed 11% and are well below the noted CRASC Management Plan target range for this objective noted earlier as 40-60% on a five year running average.

Since the first year of operation of the Vernon Dam upstream fish ladder (1981), the percent passage of American shad annually passed at Vernon compared to the number passed upstream of Turners Falls Dam (Gatehouse counts) has averaged 39.4%, ranging from 0.42% to 116.4% (> 100% due to counting error at one or both facilities, unknown).

Project Nexus

Existing project operations (peaking power generation) and limited bypass flows have a direct impact on instream flow and zones of passage (migration corridors). Project flow releases affect passage route selection, entry into fishways, and create delays to upstream migration. Inefficient downstream bypasses can result in migration delays and increased turbine passage. Mortality of adult shad passing through these turbines is expected to be high (Bell and Kynard 1985), additional stresses associated with passage and delay may cause mortality as shad are unable to return to salt water in a timely manner. The project's upstream and downstream passage facilities need to be designed and operated to provide timely and effective upstream and downstream fish passage to meet restoration goals of passage to upstream habitat and maximize post-spawn survival. These factors are all critically important to the success of restoration efforts.

Proposed Methodology

Use of radio including passive-integrated transponder (PIT) telemetry is widely accepted as the best method to assess fish migratory behavior and passage success and has been used extensively to assess migration and passage issues at Turners Falls as well as other Connecticut River projects. These studies include one conducted in 2011 and 2012 by the US Fish and Wildlife Service and U.S. Geological Survey's Conte Anadromous Fish Research Center, which has provided substantial information related to some of the issues identified here. The requested study will build and expand on the information collected over the past two years.

The study design must specify sample sizes, tag configurations and receiver configurations, to ensure that rates of entry and exit to the tailraces, fishways, downstream bypasses, and the bypassed reach can be calculated with sufficient precision to determine effectiveness of flow and ensonification treatments (separate Study Request). For project assessments at Turners Falls (e.g., Cabot, Spillway and Gatehouse ladder attraction and entry, route selection, operational effects), double tagged (radio and PIT) shad will be required for release from Holyoke Dam. Additional shad must be released directly into the Turners Falls Canal to support assessment of the various operational and structural conditions in effect, to be modified in this period, and proposed conditions within the Turners Falls power canal relative to entrances to the Gatehouse fishway. A related request on CFD modeling in the Cabot Station tailrace, the upper power canal near Gatehouse, and in the area around the entrance of the Spillway Ladder will address related project operational effects that will also address identified objectives in this telemetry request. Shad captured at Holyoke and tagged and release upstream of Turners Falls Dam, or tagged out of Gatehouse Ladder, would help to ensure an adequate sample size for evaluations in the vicinity of NMPS and to the Vernon Dam and the ability to address identified study objectives in those project areas. Additional tagged shad are expected to be required for release upstream of the Vernon Dam, which should ensure adequate sample for a separate study request, where shad spawn upstream of Vernon Dam as well as ensuring there is an adequate number of outmigrating spent adults to address related study objectives for adult outmigrants. The required number of tagged fish to address study objectives may be adjusted accordingly from area to area depending on target numbers (i.e., best information on resultant viable tagged fish and power analyses to detect effects) to account for typical passage rates, survival rates, and handling effects as examples.

Existing information on captured, handled, tagged fish performance (e.g., percent that drop back, unsuitable for tracking) and factors such as timing of tagging and potentially transport, must all be carefully considered to ensure an adequate sample size of healthy (e.g., viable to characterize behavior, survival, etc.) tagged fish is available to address the many questions identified in this request (as supported by a statistical power analysis). Additionally, ensuring adequate downstream adult fish sample sizes (to address project effect questions above) requires close consideration as expected losses of healthy tagged fish during upstream passage, natural mortality rates, and tagging related effects, are expected to reduce sample sizes on downstream passage objectives/questions as the season progresses. The use of single PIT tagged fish can help improve sample sizes, but will be of limited use to answer some of the passage questions we have identified.

Due to environmental variability, two years of study work will be necessary. A large array of stationary monitoring stations (radio and PIT) will be needed to address the issues identified among the project areas. A sufficient level of radio receiver and PIT reader coverage will be required, to provide an appropriate level of resolution, for data analyses, to answer these questions on project operational effects.

The study will provide information on a variety of structural and operational aspects of fish migration, relative to route selection, timing, survival, and up and downstream passage attraction, retention, delay, efficiency, survival as some examples at three projects (Turners Falls, NMPS, and Vernon). The use of video monitoring may also be utilized for specific study areas such as the Spillway Ladder, to provide additional information on shad entrance activity, with the understanding of some data limitations associated with this approach (fish identification, water visibility). This study will be coordinated with the proposed study request to evaluate ensonification as a shad behavioral deterrent at the Cabot Station tailrace which will be an additional treatment of the telemetry study.

In addition to the tagging studies, use of video monitoring of the Spillway Fishway would provide additional overall data on Spillway Fishway efficiency as all shad attempting to pass could be monitored versus just those shad that have been tagged.

Level of Effort and Cost

The requested study is extensive and will require a substantial effort and cost to capture, PIT tag, and radio tag a sufficient number of shad at Holyoke to release at upstream locations. We are not aware of any other study technique that would provide project specific fish behavior and migration information to adequately assess existing project operations and provide insight in possible alternative operations and measures needed to address observed negative impacts to fish migration success. Cost for the entire multi-project tagging, tracking and data analysis are expected to range from $400,000 to $500,000 based on past Turners Falls' studies and the 2011 and 2012 shad telemetry studies. Video monitoring of the Spillway fishway would add a modest cost to this study.

Due to the fact tagged shad will move throughout the larger five project area, to varying degrees, there will be expected cost savings (e.g., radio tags) to both owner/operators, provided cooperation in study planning and implementation occurs.

Literature Cited

Atlantic States Marine Fisheries Commission. 2010. Amendment #3 to the interstate fishery management plan for shad and river herring (American shad management). Washington, D.C.

Bell, C. E. and B. Kynard. 1985. Mortality of adult American shad passing through a 17- megawatt Kaplan turbine at a low-head hydro-electric dam. North American Journal of Fisheries Management, 5:33-38.

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Castro-Santos, T. and A. Haro. 2010. Gatehouse fishway telemetry studies: progress report, 2008-2010. USGS CAFRC Internal Report.

Kieffer, M. and B. Kynard. 2012. Spawning and non-spawning migrations, spawning, and effects of river regulation on spawning success of Connecticut River shortnose sturgeon. In Life history and behavior of Connecticut Rver shortnose sturgeon and other sturgeons. B. Kynard, P. Bronzi, and H. Rosenthal Editors. World Sturgeon Conservation Society: Special Publication #4. Norderstedt, Germany.

Study Request 23. Impact of Project Operations on Shad Spawning, Spawning Habitat, and Egg Deposition in the Project Areas of the Turners Falls, Northfield Mountain Pumped Storage and Vernon Project Areas and downstream from Bellows Falls Dam

Conduct a field study of spawning by American shad in the Connecticut River mainstem downstream of Turners Falls Dam, in the Turners Falls Dam impoundment, in the Vernon Dam Project area, and downstream of Bellows Falls Dam to determine if project operations (including operations of the Northfield Mountain Pump Storage) negatively impact shad spawning behavior, spawning habitat use, areal extent and quality of those spawning areas, and spawning activity in terms of egg deposition in those areas.

Goals and Objectives

Determine if project operations (under the permitted and proposed operational ranges) affect American shad spawning site use and availability, spawning habitat quantity and quality, and spawning activity in the river reaches downstream from Cabot Station and in the project bypass reach of Turners Falls Dam, in the Turners Falls Dam impoundment and in relation to Northfield Mountain Pump Storage operations, downstream and upstream of the Vernon Dam, and in the project area downstream of Bellows Falls Dam. The following objectives will address this request:

- Determine areas utilized by American shad for spawning by conducting night-time visual observation of spawning activity, identify and define areas geospatially, and obtain data on physical habitat conditions effected by project operations (e.g., water depth, velocity, discharge, substrate, exposure and inundation of habitats);
- Determine project operation effects on observed spawning activity, under a range of permitted or proposed project operation conditions;
- Quantify effects (e.g., water velocity, depths, inundation, exposure of habitats) of project operation on identified spawning areas for a range of conditions, over the complete period of spawning activity;
- Quantify spawning activity as measured by night-time spawning/splash surveys and egg collection in areas of spawning activity, and downstream of these areas, to further determine project operation effects (location extent of exposure from changing water levels and flows and on associated habitats from project operations).

If it is determined that the Project operations are adversely affecting the spawning activity of American shad and impacting spawning area habitat, identify operational regimes that will reduce and minimize impacts spawning habitat and spawning success, within the project area. This study will require two years of field data to capture inter-annual variability to river discharge and water temperatures and to allow for evaluation of alternative flow regimes if year one studies determine that the present peaking regime negatively affects spawning.

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish and their habitats are important public resources. There is a strong public interest in protecting and conserving fish and their habitats. This study will assess spawning by American shad in the Connecticut River mainstem downstream of Turners Falls Dam, in the Turners Falls Dam impoundment, in the Vernon Dam Project area, and downstream of Bellows Falls Dam to determine if project operations (including operations of the Northfield Mountain Pump Storage) negatively impact shad spawning behavior, spawning habitat use, areal extent and quality of those spawning areas, and spawning activity in terms of egg deposition in those areas.

Existing Information

Since the construction of the first fish lift facility at Holyoke Dam in 1967, American shad have had access to spawning and rearing habitat upstream from Holyoke Dam. A number of improvements to the Holyoke fishway have occurred since that time, but while the numbers of shad lifted at Holyoke have reached as much as 721,764 and the overall shad population to the river exceeded 1.6 million shad in 1992 (CRASC 1992), total shad population, and numbers of shad passing Turners Falls and Vernon Dam have not met CRASC management plan objectives. Population number and passage numbers past Holyoke have declined substantially from those totals in recent years, with average Holyoke passage numbers over the last 10 years of 211,850. Since historically approximately half of the returning population of shad to the river passed upstream of Holyoke, recent returns are far below management goals. Effective upstream and downstream passage and successful in-river spawning and juvenile production are necessary to help achieve shad management goals for the Connecticut River.

American shad broadcast spawn in congregations over shallow flats and rocky or sandy substrates (Davis et al, 1970, Mansuetti and Kolb 1953), at depths less than 10 feet and often far shallower with spawning fish swimming vigorously near the surface in a closely packed circle (Marcy 1972, Mackenzie et al 1985). Fertilized eggs drift downstream until hatching (Mackenzie et al 1985).

American shad are known to spawn downstream from the Turners Falls Project. Layzer (1974) identified 6 spawning sites from an area below the mouth of the Deerfield River (river mile 191.9) to river mile 161.7 below the Mill River in Hatfield, MA. Kuzmeskus (1977) verified 16 different spawning sites ranging from downstream of the Cabot tailrace to just upstream of the Holyoke dam (river mile 87.1). The only parameter that all spawning sites had in common was current (Kuzmeskus 1977). We are not aware of any more recent studies that document whether these 16 sites are still viable spawning locations for shad. We are not aware of any studies that have determined American shad spawning habitat or spawning sites upstream of Vernon Dam to Bellows Fall Dam (historic extent of upstream range).

First Light Power conducted studies in the late spring and summer of 2012, examined habitat conditions downstream of the Turners Falls Dam. The study documented that in low flow conditions, Cabot Station project operations produced fluctuations in water level elevations that can range over 4 feet in magnitude (daily operation) at the USGS Montague Gage Station, to lower values of 2 to 3 feet at the Route 116 Bridge, Sunderland, MA (PAD). Similar short-term, limited monitoring in the upper Turners Falls Dam impoundment identified water level changes due to project operations that d cyclically varied several feet on a sub-daily frequency.

Project Nexus

American shad are known to spawn at five locations downstream from the Turners Falls Project from an area below the mouth of the Deerfield River (river mile 191.9) and ten other locations downstream to river mile 161.7 below the Mill River in Hatfield (Layzer 1974, Kuzmeskus 1977).

Shad spawning is likely influenced by river flow, which fluctuates greatly due to the project's peaking mode of operation. These fluctuations may impact shad spawning activity by altering current velocities and water depth at the spawning sites. Effects on spawning behavior could include suspension of spawning activity, poor fertilization, flushing of eggs into unsuitable habitat due to higher peaking discharges, eggs dropping out into unsuitable substrate and being covered by sediment deposition and/or eggs becoming stranded on dewatered shoal areas as peak flows subside.

While a number of shad spawning and egg deposition studies were conducted in the 1970s, that research was aimed at assessing the potential impact of developing a nuclear power station in the Montague Plains section of the Connecticut River. We are not aware of any studies being conducted specifically designed to determine if a relationship between spawning behavior, habitat use, and egg deposition and project operations effects of the Turners Falls, Northfield Mountain Pump Storage and Vernon projects and downstream of Bellows Falls Dam..

Peaking operations may be altering spawning behavior and contributing to the failure of the Connecticut River shad population to meet management targets.

Methodology

The first year of study should examine known spawning areas downstream of the Turners Falls Dam project, to determine operation effects on shad spawning behavior, activity, and success. In areas upstream of Turners Falls Dam to the Bellow Falls Dam tailrace, the study should identify areas utilized for spawning by American shad. In the second year, should results from year one determine project operations affected spawning activity, access to habitat, or success, downstream of Turners Falls Dam, then an identical more detailed assessment (identified objectives) should be conducted in spawning areas upstream of Turners Falls Dam to the Bellows Falls Dam tailwater. Measures to reduce or eliminate any documented project operation impacts should be explored and evaluated in year two, downstream of Turners Falls Dam.

The impacts to spawning behavior would best be studied by night-time observations of actual in-river spawning behavior (Ross et al. 1993). Project discharge increases or decreases during actual observed spawning activity will provide empirical evidence of change in behaviors. The observational methodology should follow the protocol specified in Layzer (1974) and/or as described in Ross et al. (1993). The analysis should utilize the observational field data in conjunction with operational data from the projects (station generation and spill on a sub-hourly basis). To assess the impacts of changes in generation flows, the study should include scheduled changes in project operation to ensure that routine generation changes that occur during the nighttime spawning period affect downstream spawning habitats selected for study while shad are spawning. Stier and Crance (1985) provide optimal water velocities during spawning to range between 1 to 3 ft/sec.

In areas used for spawning, the characteristics of those areas (e.g., location, depth, flow, substrate) should be recorded. The effect of project operations (discharge, water velocity, inundation and exposure) should be assessed. Drift nets will be used to collect eggs to quantify egg production before and after flow changes at the spawning site.

In the reaches above the Turners Falls dam, night time observations of splashing associated with shad spawning should be done in each reach as sufficient numbers of shad are passed above each dam. Observations should be done regularly until the end of the spawning season. The use of radio-tagged adult shad from a separate Study Request will aid in this effort. An estimate of the total area used for spawning and an index of spawning activity should be recorded for each site.

Level of Effort and Cost

Neither First Light or TransCanada propose any studies to meet this need. Estimated cost for the study is expected to be moderate (up to $40,000) for each owner, with the majority of costs associated with fieldwork labor.

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CRASC (Connecticut River Atlantic Salmon Commission). 1992. A management plan for American shad in the Connecticut River basin. Sunderland, MA

Kuzmeskus, D. M. 1977. Egg production and spawning site distribution of Americans had, *Alosa sapidissima*, in the Holoke Pool, Connecticut River, Massachusetts. Master's thesis. University of Massachusetts, Amherst, MA.

Layzer, J.B. 1974. Spawning Sites and Behavior of American Shad, *Alosa sapidissima* (Wilson), in the Connecticut River Between Holyoke and Turners Falls, Massachusetts, 1972. Master of Science Thesis. University of Massachusetts, Amherst, Massachusetts.

MacKenzie, C., L. Weiss-Glanz, and J. Moring. 1985. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (mid-Atlantic) American shad. U. S. Fish and Wildlife Service Biological Report No. 82 (11.37), Washington, D.C.

Mansueti, R. J. and H. Kolb. 1953. A historical review of the shad fisheries of North America. Chesapeake Biological Laboratory Publication no. 97. Solomons, MD.

Marcy, B. C. Jr. 1972. Spawning of the American shad, Alosa sapidissima, in the lower Connecticut River. Chesapeake Science 13:116-119.

Ross, R. R., T. W. H. Backman, R. M. Bennett. 1993. Evaluation of habitat suitability index models for riverine life stages of American shad, with proposed models for premigratory juveniles. Biological Report #14. U. S. Department of the Interior, Fish and Wildlife Service, Washington, D.C.

Stier, D. J. and J. H. Crance. 1985. Habitat suitability index models and instream flow suitability curves: American shad. U. S. Fish and Wildlife Service Biological Report No. 82(10.88),Washington, D.C.

Study Request 24. Impact of Vernon Project Operations on Downstream Migration of Juvenile American Shad

Conduct a field study of juvenile American shad outmigration at the Vernon Dam to determine if project operations negatively impact juvenile shad survival and production.

Goals and Objectives

Determine if project operations affect juvenile American shad outmigration survival, recruitment, and production. The following objectives will address this request:

- Assess project operation effects of Vernon Dam on the timing, routes, migration rates, and survival of juvenile shad;
- Determine the proportion of juvenile shad that as a downstream passage route choose or are directed to existing downstream bypass structures, gate structures, or are entrained into the station turbines and assess delay, survival, timing, and related impacts with these locations under a full range of operational conditions, over the period of outmigration;
- Determine survival rates for juvenile shad entrained into Vernon Station units.

If it is determined that the project operations or related effects are adversely affecting juvenile shad survival, migration timing, or other deleterious population effects are noted, identify operational solutions or other solutions that will reduce and minimize impacts, within the project affected area. This study will require two years of field data to capture inter-annual variability of river discharge, water temperature, and variability in run size and juvenile production (and timing of developmental stages) and variability in outmigration timing which may relate to spring, summer and fall conditions.

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish and their habitats are important public resources. There is a strong public interest in protecting and conserving fish and their habitats. This study will conduct a field assessment of juvenile American shad outmigration at the Vernon Dam to determine if project operations negatively impact juvenile shad survival and production.

Existing Information

Adult shad are counted annually as they pass above the Vernon Dam. Juvenile American shad production has been monitored upstream of the Vernon Dam and immediately downstream of that dam by Vermont Yankee Nuclear as part of an annual monitoring program using both boat electrofishing (since 1991) and beach seining (since 2000). A seasonal average annual index of juvenile American shad standing crop in Vernon reservoir has been calculated since 2000. Estimates of juvenile shad growth rates in the Vernon impoundment have been calculated annually beginning in 2004, and also in a study conducted in 1995 (Smith and Downey 1995).

Although there were numerous studies of downstream passage facilities at the Vernon Project for Atlantic salmon smolts, studies passage studies for American shad were limited to tests in 1991 and 1992 of a high frequency sound field to guide fish to te fish pipe, the primary downstream fishways in 1991 and 1992 (RMC 1993). Although the studies were deemed incomplete, the technology indicated some level of response by juvenile shad. However, despite that conclusion, there is no indication that this technology or other downstream passage studies with juvenile shad were subsequently pursued.

Project Nexus

Juvenile American shad production occurs in the river reach between the Vernon Dam and the Bellows Falls Dam, which is thought to be the historic upstream limit of the shad migration in the Connecticut River. Juvenile American shad require safe and timely downstream passage measures to have the opportunity to contribute to the restoration target population size.

There is little information available regarding the total impact of the Vernon project on downstream migration of juvenile shad. Migration delays, increased predation, mortality during passage over the dam or through turbines, and changes in route selection under different flow conditions are potential influences of the Vernon Dam on the juvenile shad population in the upper Connecticut River. Effective upstream and downstream passage and successful in-river spawning and juvenile production are necessary to help achieve shad management restoration goals for the Connecticut River, particularly in the upstream reaches. Delays in juvenile American shad outmigration may affect survival rates in the transition to the marine environment (Zydlewski et al. 2003).

Proposed Methodology

The impact to juvenile shad outmigrants would be best studied by a combination of approaches including hydroacoustics, radio telemetry (including passive integrated transponder (PIT) telemetry), and turbine balloon tags. Project discharge adjustments at the dam should be examined relative to timing, duration, and magnitude of juvenile shad migration to and through the dam, with hydroacoustic equipment for natural/wild fish information. In addition, study fish should be collected and tagged (PIT, radio, balloon) to then empirically determine rates of survival for fish passed through the project under varied operations, from minimum flows up to full spill conditions. The release of tagged fish (radio, PIT) at a number of potential sites will provide data on delay and route selection as juvenile shad move through the Vernon project area. The number and location of release sites will depend on the availability of tagged fish.

Additional hydroacoustic assessment immediately upstream and downstream of the Vernon Dam will provide information on the timing of migration to and through this area. A more focused survival study, using balloon tags, PIT tags, or other appropriate methods, should be conducted in the second year based upon the first year of study findings relative to the frequency, magnitude, timing, and route selection of juvenile American shad through the Vernon project.

Level of Effort and Cost

TransCanada does not propose any studies to meet this need. Estimated cost for the study is expected to be up to $150,000 with the majority of costs associated with equipment (hydroacoustic gear, radio tags, radio receivers, and PIT readers) and related fieldwork labor.

Literature Cited

RMC Environmental Services, Inc. 1993. Effect of ensonification on juvenile American shad movement and behavior at Vernon Hydroelectric Station, 1992 – Draft Report, March 1993.

Smith, R. L., and P. C. Downey. 1995. Vermont Yankee/Connecticut River System Analytical Bulletin 69: Relative density and growth of juvenile American shad in the Connecticut River near Vernon, Vermont, 1995.

Zydlewski, J., S. D. McCormick, and J. G. Kunkel. 2003. Late migration and seawater entry is physiological disadvantageous for American shad juveniles. Journal of Fish Biology #63, 1521-1537.

Study Request 25. American Eel Survey Upstream of the Vernon, Bellows Falls, and Wilder dams

Goals and Objectives

The goal of this study is to provide baseline data relative to the presence of American eel upstream of the Vernon, Bellows Falls, and Wilder dams.

The objective of the study is to determine the relative abundance and distribution of American eel upstream of the Vernon, Bellows Falls and Wilder dams in both riverine and lacustrine habitat.

Relevant Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish and their habitats are important public resources. There is a strong public interest in protecting and conserving fish and their habitats. The American eel (*Anguilla rostrata*), is listed as one of both New Hampshire's and Vermont's Species of Greatest Conservation Need (SGCN). As outlined in Vermont's Wildlife Action Plan (Kart et al. 2005), research and monitoring needs for this SGCN include determining their distribution and abundance, as the contribution of eels in northern regions to overall stock is unknown. This study will determine the relative abundance and distribution of American eel upstream of the Vernon, Bellows Falls and Wilder dams in both riverine and lacustrine habitat. One of the conservation strategies for this species is to support efforts to enhance access of American eels to Vermont waters by eliminating or minimizing impacts of dams and other obstructions along the Richelieu, St. Lawrence, and Connecticut Rivers.

Existing Information

According to the PADs, very few American eels were collected in the Fish Assemblage and Habitat Assessment of the Upper Connecticut River (Yoder et al., 2009). In the Vernon Project area upstream of the dam, only one eel was collected; no eels were collected from the Bellows Falls pool, and none were found upstream of the Wilder Dam. However, in 2012 over 200 eels were documented using the upstream fish ladder at the Vernon Project and the New Hampshire Fish and Game Department has observed eels upstream of the Bellows Falls and Wilder dams. More recently, eels have been observed in Lake Morey, Vermont, which is located upstream of Wilder Dam (Lael Will, VDFW, personal communication). Therefore, while it is clear that some eels are passing all three dams (Vernon, Bellows Falls, and Wilder), it remains unknown how many eels may be rearing in the mainstem habitat upstream of the dams or in tributaries and lakes and ponds that feed into the mainstem river.

No targeted eel surveys have been conducted to determine the abundance and distribution of American eels in riverine and lacustrine habitat upstream of the three projects. This information gap needs to be filled so resource agencies can evaluate properly the need for, and timing of, downstream passage and protection measures for outmigrating silver phase eels.

It should be noted that within the past seven years, the US Fish and Wildlife Service has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005 the Service issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability. On September 29, 2011 the Service issued a substantial 90-day finding and initiated a 12-month status review. The Service is still accepting new American eel information for the ongoing status review. The Service also is currently in settlement negotiations with CESAR on their legal complaint that the Service failed to complete the 12-month finding within the statutory timeframe. It is likely that the Service's 12-month finding on the latest petition will be made prior to any new licenses being issued for the projects.

Project Nexus

The project configurations present problems with respect to providing safe, timely and effective passage for outmigrating eels. The intakes are deep and, while no specification for the trashracks were provided in the PADs, it is unlikely that they would prevent impingement and/or entrainment of eels. Existing anadromous downstream passage facilities at the projects also would not be expected to be effective for eels; the target anadromous species are surface-oriented, while eels tend to move much deeper in the water column. If eels are utilizing habitat upstream of the dams, then appropriate protection and downstream passage measures will be needed.

In order to understand the need for, and timing of, downstream eel passage at the projects, we are requesting that TransCanada undertake eel surveys in the Connecticut River upstream of the three dams and in tributaries feeding into the mainstem river within the project areas. Surveying tributary habitat is necessary because surveying the mainstem alone may lead to an underestimation of eel abundance, particularly if there are relatively short tributary streams that lead to a lake or pond (where eels may accumulate, leading to true high densities).

Proposed Methodology

We request an eel survey be conducted in the mainstem river an tributaries upstream from the three projects. The methodology should be similar to that used in the relicensing of the Saluda Hydroelectric Project, FERC No. 516 (Appendix A), the eel assessment for the Merrimack River completed by the Service’s Central New England Fishery Resources Office (Appendix B), and the proposed study plan for the relicensing of the Eastman Falls Project (FERC No. 2457)[3].

In general, a combination of electroshocking (backpack in wadeable rivers and boat-mounted in larger rivers and lakes) and eel pots should be used to collect eels and determine catch rates. Sampled habitat should include: the mainstem Connecticut River from upstream of Vernon Dam to below the Ryegate Dam; tributaries to the Connecticut within that stretch where eels have been collected previously; and lakes and ponds (such as, but not limited to, Spofford Lake and Lake Morey), where eels have been collected previously. Sampling should occur during the summer (July through September).

[3] FERC Accession No. 20121214-5121

Level of Effort and Cost

The expected level of effort and anticipated costs will be comparable to that experienced on similar FERC projects of this size. A study plan recently submitted for the Eastman Falls Project (FERC No. 2457) on the Pemigewasset River in New Hampshire, which is utilizing a similar methodology, estimated that sampling a nine-mile-long impoundment with shocking and eel pots would cost $25,000. They estimated the effort to be two nights for the electrofishing survey. Given the much larger area that will need to be sampled under this request, we estimate moderate cost and effort will be required (20 days of shocking mainstem habitat plus another 5-10 days for tributaries and associated lake/pond habitat).

Literature Cited

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department. Waterbury, Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm. (Accessed September 10, 2012).

Study Request 26. Evaluation of Timing of Downstream Migratory Movements of American Eels on the Mainstem Connecticut River

Goals and Objectives

The goal of this study is to better understand migration timing of adult, silver-phase American eels as it relates to environmental factors and operations of mainstem hydropower projects on the Connecticut River.

The objectives of this study are:

Quantify and characterize the general migratory timing and presence of adult, silver-phase American eels in the Connecticut River relative to environmental factors and operations of mainstem river hydroelectric projects

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish and their habitats are important public resources. There is a strong public interest in protecting and conserving fish and their habitats. This study will improve our understanding of migration timing of adult, silver-phase American eels as it relates to environmental factors and operations of mainstem hydropower projects on the Connecticut River.

Existing Information

Data on timing of downstream migratory movements and rates of American eels in the mainstem Connecticut River are sparse and relatively incomplete. Preliminary data on presence of "eel-sized" acoustic targets have been collected (Haro et al. 1998) within the Turners Falls Project's Cabot Station forebay that were somewhat confirmed by video monitoring at the Cabot Station downstream fish bypass; however, these were short-term studies, with acoustic monitoring only performed from 17 September to 5 October and video monitoring only conducted between 18 September to 22 October.

Some daily monitoring of the downstream bypass at the Holyoke Dam (canal louver array) was performed in 2004 and 2005 (Kleinschmidt, Inc. 2005, 2006, Normandeau Associates 2007); these studies also were of relatively short duration (spanning from October 5 to November 10 in 2004 and September 9 to November 11 in 2005) and the sampler was only operated at night.

To date, no other directed studies of eel migratory movements have been conducted at any location on the Connecticut River mainstem. This information gap needs to be filled, as it relates directly to when downstream passage and protection measures need to be operated.

We also note that within the past seven years, the Service has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005 the Service issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability. On September 29, 2011 the Service issued a substantial 90-day finding and initiated a 12-month status review. The Service is still accepting new American eel information for the ongoing status review. The Service also is currently in settlement negotiations with CESAR on their legal complaint that the Service failed to complete the 12-month finding within the statutory timeframe. Although the date for completion of the Service's 12-month finding on the latest petition is uncertain, it is likely that it will be made before any new licenses are issued for the projects.

Project Nexus

The timing of downstream migration of adult eels is poorly defined for the Connecticut River; therefore the general effects of hydroelectric project operations on eel survival to the ocean are unknown. Although separate study requests have been submitted to address project-specific downstream passage route selection, delays, and mortality of eels, general characteristics of river flow and environmental conditions may have significant relationships with project operation and eel migratory success and survival. For example, eels may tend to move immediately before or during periods of significant precipitation (or consequently river flow); times at which projects may be generating at maximum capacity or spilling, which may (or may not) present a higher passage risk to eels. Conversely, periods of low flow may be associated with a significant proportion of total river flow passing through turbine units, which present additional (or different) passage risk to eels. If discrete conditions which promote eel downstream migration are known, it may be possible to take actions with respect to project operations which reduce or minimize passage risk; i.e., operation of a bypass, reduction of intake approach velocities, directed spillage through a “safe” route, etc. These studies should provide baseline information on river-specific downstream migration to predict when silver-phase eels are expected to be migrating in the mainstem Connecticut River, from which project operations could be modified to minimize passage risks.

The studies are proposed for a single or multiple sites; the results will be relevant to all sites on the Connecticut River mainstem.

Proposed Methodology

Quantification of downstream movements of American eels in river systems requires systematic sampling of migrants throughout the migratory season. This can be accomplished with traditional active trapping methods; i.e., fyke or stow net sampling, weirs, or eel racks, but these methods are technically challenging on larger mainstem rivers, due to the scale of flows that need to be sampled, difficulties in operation throughout all flow conditions, and high debris loading during fall flows. Passive monitoring of migrant eels using hydroacoustic methods offers an alternative to active trapping. However, passive monitoring requires verification of potential acoustic targets with some level of active (collection) or visual (traditional optical or acoustic video) sampling.

Two potential locations offer opportunities to conduct simultaneous passive and active sampling: the Cabot Station (Turners Falls project) canal/forebay and the Holyoke Dam forebay and canal louver/bypass system. Each location possesses a route of downstream passage which conducts a significant proportion of river flow (Cabot canal and Holyoke forebay or canal), and each has a proximal bypass equipped with a sampler so that fish can be concentrated/collected from the passage route and identified to species. Project operations do influence the relative proportion of flow (and thus numbers of downstream migrant eels) in each passage route, so numbers of eels sampled in each route represent only a proportion of the total number of eels migrating downstream within the entire river. Because the absolute proportion of eels using a specific route at any one time is unknown, numbers of eels quantified within a route must serve as a relative index of the degree of migratory movement.

This study shall quantify eel movements in either one, or preferably both, locations for two consecutive years (since environmental conditions strongly influence migratory timing of eels, which can vary significantly from year to year; Haro 2003). Eels will be quantified using methods similar to Haro et al. (1999), by continuously monitoring a fixed location at the projects with hydroacoustics. Because eels tend to concentrate in areas of dominant flow (Brown et al. 2009, EPRI 2001), the zone to be monitored should pass a dominant proportion of project flow throughout most periods of operation (i.e., forebay intake area). Hydroacoustic monitoring shall encompass the entire potential migratory season, beginning in mid-August and ending in mid-December, and shall operate 24 hours per day. Data will be recorded for later processing and archiving.

Systematic active quantification of eels at downstream bypass samplers shall be performed simultaneously with passive hydroacoustic monitoring, to verify presence of eels and relative abundance of eel-sized hydroacoustic targets from the hydroacoustic data. Although daily operation of the bypass sampler could be performed, a more comprehensive technique is to monitor eels entering the bypass with an acoustic camera (i.e. DIDSON, BlueView, etc.). The acoustic camera will afford positive visual identification of eels as they enter the bypass, which is a concentration point for migrating eels. Acoustic camera monitoring will also allow monitoring to be performed 24 hours a day, and will be relatively unaffected by water turbidity (which influences effectiveness of traditional optical video monitoring). The acoustic camera system will be operated during the same time period as acoustic monitoring, and images will be recorded for later processing and archiving.

Data analyses of hydroacoustic, acoustic camera, bypass sampling, and environmental/ operational data will follow standard methodology.

Project operation (flows, levels, gate openings, number of units operating and operation level) and environmental conditions (river flow, temperature, turbidity, air temperature, precipitation) will be monitored regularly (hourly measurements if possible) throughout the duration of the studies.

These methodologies are consistent with accepted practice.

Level of Effort and Cost

The level of cost and effort for the downstream migrant eel migratory timing study would be moderate, given the level of cost for instrumentation, deployment, and data review/analysis. Cost is estimated at $50,000 per year for the study.

The applicant did not propose any studies to meet this need in the PAD.

Literature Cited

Brown, L.S. 2005. Characterizing the downstream passage behavior of silver phase American eels at a small hydroelectric facility. M.Sc. Thesis, Department of Natural Resource Conservation, University of Massachusetts, Amherst, Massachusetts. 110 pp.

Brown, L., A. Haro, and T. Castro-Santos. 2009. Three-dimensional movement of silver-phase American eels in the forebay of a small hydroelectric facility. Pages 277-291in: J. Casselman et al. editors. Eels at the Edge: Science, Status, and Conservation Concerns. American Fisheries Society, Bethesda, MD.

EPRI (Electric Power Research Institute). 2001. Review and documentation of research and technologies on passage and protection of downstream migrating catadromous eels at hydroelectric facilities. EPRI Technical Report No. 1000730, Palo Alto, California 270 pp.

Haro, A. 2003. Downstream migration of silver-phase anguillid eels. Pages 215-222 in: Aida, K., K. Tsukamoto, and K. Yamauchi, eds. Eel Biology. Springer, Tokyo.

Haro, A., D. Degan, J. Horne, B. Kulik, and J. Boubée. 1999. An investigation of the feasibility of employing hydroacoustic monitoring as a means to detect the presence and movement of large, adult eels (Genus *Anguilla*). S. O. Conte Anadromous Fish Research Center Internal Report No. 99-01. Turners Falls, Massachusetts. 36 pp.

Kleinschmidt, Inc. 2005. Factors influencing the timing of emigration of silver-phase American Eels, *Anguilla rostrata*, in the Connecticut River at Holyoke MA. Submitted to the City of Holyoke Holyoke Gas and Electric Department. 27 pp.

Kleinschmidt, Inc. 2006. Holyoke Project (FERC No. 2004) silver-phased American eel flow priority plan. Submitted to the City of Holyoke Holyoke Gas and Electric Department. 51 pp.

Normandeau Associates, Inc. 2007. American eel emigration approach and downstream passage routes at the Holyoke Project, 2006. Submitted to the City of Holyoke Holyoke Gas and Electric Department. Final report. Normandeau Associates, Inc., Westmoreland, New Hampshire. 81 pp.

Study Request 27. Upstream American Eel Passage Assessment at Vernon, Bellows Falls and Wilder Projects

Goals and Objectives

This study has two objectives:

1. Conduct systematic surveys of eel presence/abundance at tailrace and spillway locations at the Vernon, Bellows Falls, and Wilder projects to identify areas of concentration of eels staging in pools or attempting to ascend wetted structures that would potentially establish the most effective locations to place upstream eel passage facilities.
2. Collect eels with temporary trap/pass devices from areas identified from surveys as potential locations of eel concentration to assess whether eels can be collected/passed in substantial numbers, and whether locations are viable sites for permanent eel trap/pass structures.

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish and their habitats are important public resources. There is a strong public interest in protecting and conserving fish and their habitats. The American eel (*Anguilla rostrata*), is listed as one of both New Hampshire's and Vermont's Species of Greatest Conservation Need (SGCN). As outlined in Vermont's Wildlife Action Plan (Kart et al. 2005), research and monitoring needs for this SGCN include determining their distribution and abundance, as the contribution of eels in northern regions to overall stock is unknown. This study will conduct systematic surveys of eel presence/abundance at tailrace and spillway locations at the Vernon, Bellows Falls, and Wilder projects to identify areas of concentration of eels staging in pools or attempting to ascend wetted structures that would potentially establish the most effective locations to place upstream eel passage facilities. One of the conservation strategies for this species is to support efforts to enhance access of American eels to Vermont waters by eliminating or minimizing impacts of dams and other obstructions along the Richelieu, St. Lawrence, and Connecticut Rivers.

Existing Information

The PAD contains no information relative to areas where eels seeking to move upstream concentrate downstream of the three dams, or annual numbers of eels attempting to ascend past the dams. While eels have been known to ascend the Vernon and Bellows Falls fish ladders, their efficiency for passing eels is unknown, and they are only operated during the American shad passage season (from April 15 through July 15). Eels are currently able to pass Vernon, Bellows Falls, and Wilder dams (as evidenced by documented presence of eels upstream), but the total number of eels attempting to pass all three dams and the proportion successfully passing each project is unknown (but suspected to be low). The downstream Holyoke Project has operated upstream eel passage facilities since 2004. Last year these facilities passed over 40,000 juvenile eels. While the next dam upstream (the Turners Falls Project; FERC No. 1889) has no dedicated upstream eel passage facilities, eels have been known to ascend the Cabot Station fish ladder (A. Haro, U.S. Geological Survey, pers. comm.). Although there is rearing habitat in between the Turners Falls and Vernon dams, some eels will attempt to continue upstream, and passage needs to be provided so these fish can access historical habitat.

These information gaps need to be filled so resource agencies can determine the best locations to site upstream eel passage facilities and assess whether operating the existing anadromous ladders would be an effective mechanism to move juvenile eels upstream past the projects.

We also note that within the past seven years, the US Fish and Wildlife Service has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005 the Service issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability (CEASAR). On September 29, 2011 the Service issued a substantial 90-day finding and initiated a 12-month status review. The Service is still accepting new American eel information for the ongoing status review. The Service also is currently in settlement negotiations with CESAR on their legal complaint that the Service failed to complete the 12-month finding within the statutory timeframe. Although the date for completion of the Service's 12-month finding on the latest petition is uncertain, it is likely that it will be made before any new licenses are issued for the projects.

Project Nexus

The three projects generate hydropower on the head created by the Vernon, Bellows Falls, and Wilder dams. These dams create barriers to upstream migrating eels. While some eels are able to pass dams, some are not, and the passability of a given dam depends on factors such as its height, hydraulics, presence of climbable surfaces, presence of predators, risk of exposure to heat or drying while climbing a dam, etc. All three dams are high (Vernon: 58 ft. high; Bellows Falls: 30 ft. high; and Wilder: 60 ft. high), and the majority of the dam faces are dry during most of the upstream eel passage season. Design of the dams is not currently amenable to passage of eels by climbing. As mentioned earlier, the existing anadromous passage facilities are not designed to pass eels, and even if some eels are able to ascend the ladders, they may incur delays (in attraction or passage rates), be size-selective (e.g. velocity barrier for small eels presented by ~8 ft/sec flow through weirs and orifices), present a potential predation risk (predators in or near the fishways), and are not operated throughout the upstream eel passage season.

Proposed Methodology

1. Objective 1: Systematic Surveys

Surveys of eel presence and relative abundance should be conducted at regular intervals throughout the eel upstream migratory season (~1 May to ~15 October, or when river temperatures exceed 10 C). Surveys should consist of visual inspection and trapping in likely areas where eels may concentrate as they attempt to climb structures wetted by significant spill or leakage flow below the dams and associated structures. These locations include: the upstream fish ladders at all three projects (dewatered state) and leakage or overflow points along the downstream faces of all three dams, including spillways. Methods should include visual surveys (on foot, from a boat, or snorkeling) and trapping using small mesh (< 1/8" clear opening) baited eel pots. Visual surveys should be performed once per week, at night, preferentially during precipitation events. Trap sets should be performed once per week, with an overnight soak time.

Recorded data should include location, observation of eels (presence, absence, relative numbers, relative sizes, behaviors, time/date of observation), and survey method.

2. Objective 2: Trap/Pass Collections

Areas identified from Systematic Surveys as having significant number of eels present should be targeted as potential areas for permanent eel trap/passes, and should be initially assessed using temporary/portable trap passes. At a minimum (regardless of survey results), temporary trap passes should be installed at stilling basins and/or lower sections of fishways supplied with minimal attraction flow (0.5-1.0 cfs) during dewatered conditions at all three projects , as these locations may be supplemented with additional attraction flow and have high potential for being concentration points for upstream migrant eels. Similarly, traps should also be placed at spillway or bypass channel locations where eels have a potential to climb wetted (e.g., via leakage) flow zones, at the highest points where eels are able to climb to, or where otherwise feasible. Temporary trap/passes should be purpose-designed and built for each location, and operated throughout the eel upstream migratory season (~1May to 15 October, or when river temperatures exceed 10° C). Ramp-type traps with supplementary attraction flow are preferred temporary trap/pass designs. Traps should operate daily, with catches quantified every 2-3 days. Recorded data should include location, trapping interval, absolute numbers of eels trapped, relative eel sizes, and hydraulic and environmental conditions during the trapping period.

All collected eels from surveys should be released at their point of capture; those eels collected from trap/pass collections should be transported to and released into the headponds upstream of where they were collected.

These methodologies are consistent with accepted practice.

Level of Effort and Cost

The level of cost and effort for the survey component of the study would be low for each individual project (moderate for all three projects combined); a minimal number of personnel may be able to conduct the weekly surveys. The trap/pass component would require low to moderate cost and effort. We estimate $40,000 per project to conduct this study.

We are not aware of any previously conducted or ongoing studies related to upstream eel passage. The applicant did not propose any studies to meet this need in the PAD.

Literature Cited

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department. Waterbury, Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm. (Accessed September 10, 2012).

Study Request 28. Downstream American Eel Passage Assessment at Vernon, Bellows Falls, and Wilder

Goals and Objectives

The goal of this study is to determine the impact of three hydroelectric projects on the outmigration of silver eels in the Connecticut River. Entrainment at the conventional turbines at the Vernon, Bellows Falls, and Wilder projects can result in mortality or injury. It is important to understand the passage routes at each project and the potential for delay, injury, and mortality to assess alternative management options to increase survival.

The objectives of this study are:

1. Quantify the movement rates (including delays) and relative proportion of eels passing via various routes at the projects (i.e. through the turbines, through the downstream bypasses; spilled at the dams, etc.).

2. Evaluate instantaneous and latent mortality and injury of eels passed via each potential route.

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish and their habitats are important public resources. There is a strong public interest in protecting and conserving fish and their habitats. This study will determine the impact of three hydroelectric projects on the outmigration of silver eels in the Connecticut River. Entrainment at the conventional turbines at the Vernon, Bellows Falls, and Wilder projects can result in mortality or injury. It is important to understand the passage routes at each project and the potential for delay, injury, and mortality to assess alternative management options to increase survival.

Existing Information

The PAD contains information on the biology and life history of the American eel. It also summarizes eel collection data within the Vernon and Bellows Falls project areas. Eels have been collected both upstream and downstream of the Vernon Project and also have been counted passing the upstream anadromous fish ladder. Eels also have been documented upstream of the Bellows Falls and Wilder projects.

To date, no directed studies of eel entrainment or mortality have been conducted at any of the projects. These information gaps need to be filled so resource agencies can assess the relative and cumulative impact of project operations on outmigrating eels and develop adequate passage and protection measures to meet management goals and objectives.

We also note that within the past seven years, the US Fish and Wildlife Service has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005 the Service issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability (CESAR). On September 29, 2011 the Service issued a substantial 90-day finding and initiated a 12-month status review. The Service is still accepting new American eel information for the ongoing status review. The Service also is currently in settlement negotiations with CESAR on their legal complaint that the Service failed to complete the 12-month finding within the statutory timeframe. Although the date for completion of the Service's 12-month finding on the latest petition is uncertain, it is likely that it will be made before any new licenses are issued for the projects.

Project Nexus

The Vernon, Bellows Falls, and Wilder projects operate as peaking facilities, except during periods when inflow exceeds the hydraulic capacities of the stations. Silver eels outmigrate during the mid- summer through late fall, a time of year when flows are generally within the operating capacities of the stations. Therefore, the projects would be expected to spill infrequently during the silver eel outmigration.

The project configurations present problems with respect to providing safe, timely and effective passage for outmigrating eels. The intakes likely are deep and, while no specification for the trashracks were provided in the PADs, it is unlikely that they would prevent impingement and/or entrainment of eels. Existing anadromous downstream passage facilities at the projects also would not be expected to be effective for eels; the target anadromous species are surface-oriented, while eels tend to move much deeper in the water column. Eels are known to occur upstream of the dams; therefore, it is necessary to understand how eels move through the projects and the level of injury or mortality caused by entrainment through the projects' turbines.

Proposed Methodology

In order to understand the movements of outmigrating silver eels as they relate to operations at the Vernon, Bellows Falls, and Wilder projects, radio telemetry technology should be utilized. Radio telemetry is an accepted technology that has been used for a number of studies associated with hydropower projects, including at the Muddy Run Project (FERC No. 2355).

Studies should be designed to investigate route selection (i.e., entrainment vs. spill) independently from estimation of mortality/injury, because these metrics require different telemetric methodologies. Studies also will likely benefit from data collected over both study years (especially route selection studies, which may be more significantly affected by environmental conditions during a given season that mortality/injury studies). It is also envisioned that results from route selection studies can guide design of turbine mortality studies. Therefore, it is proposed, at a minimum, that route selection studies be conducted in multiple years, but mortality/injury studies may be conducted after the first year of route selection studies has been completed.

1. Objective 1: Route Selection

This study will involve systematic releases of radio-tagged silver phase eels at strategic points above areas of interest, to assess general routes of passage (i.e., via spill, bypass, or turbines). Active downstream migrants should be collected within-basin if possible (i. e., Cabot or Holyoke bypass samplers), but fish sourced from out of basin may be acceptable to meet sample size demands. Experimental fish must meet morphometric (e.g. eye diameter relative to body size) criteria to ensure they are migrant silver phase. Collections should be made within the migratory season (late Aug to mid Oct), and eels should be tagged and released within 21 days after capture, but preferably within seven days (particularly if the test eels are from out-of-basin).

All telemetered eels will be radio and passive integrated transponder (PIT) tagged. PIT antennas will be installed at bypasses at Vernon and Bellows Falls and monitored continuously to verify passage of eels via bypass channels.

Vernon Project Route Selection Study:

A minimum number of 50 telemetered eels (e.g., 5 separate groups of approximately 10 eels each) will be required to maximize the data return. Tagged eels should be released at least 5 km upstream of the Vernon project. Groups of eels should be released during spill and non-spill periods if possible. Telemetry receivers and antennas should be located to assess passage via the following potential routes: Vernon spillway; Fishway attraction water intake (if operational); Vernon downstream bypasses; and Vernon Station turbines.

Eels from the Bellows Falls route studies migrating to the Vernon Dam may be used to supplement (but not serve in lieu of) these release groups.

Bellows Falls Dam Route Selection Study:

A minimum number of 50 telemetered eels (e.g., 5 separate groups of approximately 10 eels each) will be required to maximize the data return. Groups of eels should be released during spill (if any) and non-spill and during periods of low, moderate, and high generation conditions, if possible. Tagged eels should be released at least 5 km upstream of the Bellows Falls Dam. If significant spillage occurs during releases, up to 50 additional eels should be released in the upper canal and allowed to volitionally descend through the canal to assure that sufficient number of eels are exposed to canal and powerhouse intake conditions. Telemetry receivers and antennas should be located upstream and downstream of the spillway, at the canal entrance, within the canal, in the fish downstream fish bypass entrance and turbine intakes and in mainstem below Bellows Falls Station to assess passage via the following potential routes: entrainment into the canal; passage over the spillway; into the upstream fishway attraction water intake (this should operated during the study to assess its use by eels as it may be operational in the future for riverine or eel passage as addressed in the Resident Fish Passage study request); the downstream fish bypass; and station turbines.

Eels from the Wilder route study migrating to the Bellow Falls Project may be used to supplement (but not serve in lieu of) these release groups.

Wilder Project Route Selection Study:

A minimum number of 50 telemetered eels (e.g., 5 separate groups of approximately 10 eels each) should be required to maximize the data return. Tagged eels should be released at least 5 km upstream of the Wilder Project. Groups of eels should be released during spill and non-spill periods if possible. Telemetry receivers and antennas should be located to assess passage via the following potential routes: Wilder spillway; Fishway attraction water intake (if operational); Wilder downstream bypasses; and Wilder Station turbines.

Mobile tracking (i.e., via boat) in river reaches between release sites and several km downstream of Vernon Station will be performed at regular intervals during and after releases to confirm routes and fates of passed fish, or fish lost to follow-up.

Movement rates (time between release and detection at radio antenna locations, and between radio antenna locations) of eels passing the projects by various routes will also be quantified.

The route selection portion of this study should occur in both study years.

2. Objective 2: Spill, Bypass, and Turbine Mortality/Injury Studies

Spill, bypass, and turbine mortality will be assessed using a radio-telemetric balloon tag method. A minimum number of 50 tagged eels (e.g., 5 separate groups of approximately 10 eels each) will be required at each location (dam spillways, downstream bypasses, and station turbines) to maximize the data return.

For spill mortality sites (dam spillways and downstream bypasses), tagged eels will be injected or released into spill flow at points where water velocity exceeds 10 ft/sec, to minimize the possibility of eels swimming upstream into the headpond or canal. Passed balloon-tagged eels will be recovered below areas of spill and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged eels will be censored from the data.

For turbine mortality sites (Vernon, Bellows Falls, and Wilder stations), tagged eels will be injected into intakes of units operating at or near full generation at points where intake water velocity exceeds 10 ft/sec, to minimize the possibility of eels swimming back upstream through the intakes. Passed balloon-tagged eels will be recovered in the tailrace and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged eels will be censored from the data.

If the balloon tag mortality component of the study occurs in Study Year 1 then all possible route selection sites would need to be evaluated. If the balloon tag mortality component of the study occurs in Study Year 2, then results from the route selection study (Year 1) could be used to inform which sites need to be evaluated for mortality.. Eels recovered from balloon tag studies should not be used for route selection studies.

Data analyses of route selection and turbine mortality (instantaneous and latent) will follow standard methodology.

Project operation (flows, levels, gate openings, number of units operating and operation level) and environmental conditions (river flow, temperature, turbidity, air temperature, precipitation) will be monitored regularly (hourly measurements if possible) throughout the duration of the studies.

These methodologies are consistent with accepted practice.

Level of Effort and Cost

The level of cost and effort for the downstream eel passage study would be moderate to high; silver eels would need to be collected, tagged, and released in several locations over the course of the migration season. Antennas and receivers would need to be installed at the intakes of all stations as well as at the dam spillways and Station bypasses, and monitored regularly. Data would need to be retrieved periodically, then analyzed. A multi-site route selection study conducted by the USGS Conte Lab on the Shetucket River in Connecticut cost approximately $75,000 for the first year of study. Costs are estimated at $100,000 per year for the Route Selection studies and $75,000 per year for the Spill, Bypass, and Turbine Mortality/Injury Studies, for each project.

The applicant did not propose any studies to meet this need in the PAD.

Literature Cited

Brown, L.S. 2005. Characterizing the downstream passage behavior of silver phase American eels at a small hydroelectric facility. M.Sc. Thesis, Department of Natural Resource Conservation, University of Massachusetts, Amherst, Massachusetts. 110 pp.

Brown, L., A. Haro, and T. Castro-Santos. 2009. Three-dimensional movement of silver-phase American eels in the forebay of a small hydroelectric facility. Pages 277-291in: J. Casselman et al. editors. Eels at the Edge: Science, Status, and Conservation Concerns. American Fisheries Society, Bethesda, MD.

EPRI (Electric Power Research Institute). 2001. Review and documentation of research and technologies on passage and protection of downstream migrating catadromous eels at hydroelectric facilities. EPRI Technical Report No. 1000730, Palo Alto, California 270 pp.

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department. Waterbury, Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm. (Accessed September 10, 2012).

Study Request 29. Assessment of Adult Sea Lamprey (*Petromyzon marinus*) Spawning within the Wilder, Bellows Falls, and Vernon Project Areas

Perform a study to investigate potential impacts of the Wilder, Bellows Falls and Vernon Project's operations on sea lamprey spawning success.

Goals and Objectives

Assess the level of spawning activity by sea lamprey in the Wilder, Bellows Falls, and Vernon project areas and determine whether operations of these Projects are affecting the success (i.e survival to emergence) of this activity.

Identify areas within the Wilder, Bellows Falls, and Vernon project areas where suitable spawning habitat exists for sea lamprey.

Conduct a telemetry study of sea lamprey during their upstream migration period in the spring, focusing on areas of suitable spawning habitat, and areas of known spawning.

Conduct spawning ground surveys to observe the utilization of this habitat for spawning purposes, and hence, confirm suitability.

Obtain data on redd characteristics including location, size, substrate, depth and velocity.

Determine if the operations at the Wilder, Bellows Falls and Vernon projects are adversely affecting these spawning areas (i.e. if flow alterations are causing dewatering and/or scouring of sea lamprey redds). If it is determined that the operations of the projects are adversely affecting the spawning success of sea lamprey, identify operational regimes that will reduce and minimize impacts to sea lamprey spawning habitat and spawning success within the project area.

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish and their habitats are important public resources. There is a strong public interest in protecting and conserving fish and their habitats. The sea lamprey (*Petromyzon marinus*), within the Connecticut River drainage, is one of New Hampshire and Vermont's Species of Greatest Conservation Need (SGCN). The conservation status of sea lamprey in New Hampshire is listed as "vulnerable." This study will investigate potential impacts of the Wilder, Bellows Falls and Vernon Project's operations on sea lamprey spawning success.

Existing Information

It is known that sea lamprey spawn in the Connecticut River main stem at least as far upstream as Wilder Dam, as well as tributary waters including the West, Williams, Black and White Rivers (Kart et al. 2005).

The PAD discusses sea lamprey distribution as: "FWS (2012) lists the current upstream extent of sea lamprey range as Bellows Falls Dam, noting, however, that reproduction has been documented as far north as the White River, Vermont, in the Wilder Project area. In certain years hundreds to thousands of sea lamprey have been recorded passing upstream of Bellow Falls dam, and in at least one year (2008) sea lamprey were documented passing upstream via the Wilder Dam fish ladder. In 2008 surveys, Yoder et al. (2009) documented sea lamprey just downstream of the confluence of the White River."

In 2012 at total of 99 sea lamprey were observed passing the Bellows Falls Dam, and a total of 696 sea lamprey were observed passing the Vernon Dam.

To date no studies have been conducted that aim to identify spawning habitat and spawning activity of sea lamprey within in the Wilder, Bellows Falls, and Vernon project areas and whether Project operations are affecting these activities.

Project Nexus

The operation of the Wilder, Bellows Falls and Vernon projects including minimum flows and large and rapid changes in flow releases from the dam have the potential to cause direct adverse effects on spawning habitat and spawning activity downstream of the dam. If adult sea lampreys are actively spawning in the project area, it is important to assess whether operations of the projects are having any adverse effects (i.e. dewatering and scouring) on these activities.

Proposed Methodology

Although a relatively new practice, the tagging and tracking of adult Pacific lamprey to determine final destination, has been successfully conducted in the Columbia River (Noyes et al. 2012). Similarly, from 2005-2009, radio telemetry was used to determine adult lamprey overwintering and spawning habitats, and spawn timing in the lower Deschutes River Subbasin (Fox et al. 2009).

In Vermont, factors affecting sea lamprey survival were examined (Smith and Marsden 2009). It was found that predation, water currents, and displacement of eggs from the nest, played a role in survival.

As part of the Wells Hydroelectric project (FERC No. 2149), Pacific lamprey spawning ground surveys were conducted to determine project effects on spawning success.

In 2010, redd surveys were completed in Shitike and Beaver Creeks to identify recent redds for placement of an experimental redd cap. The purpose of capping lamprey redds was to enumerate emerging larvae and to document timing of emergence with respect to estimated date of redd construction and water temperature (Fox et al. 2010). Therefore, to determine project effects on the spawning success of sea lamprey methods should follow Fox et al. (2010).

Level of Effort and Cost

The estimated level of effort and costs for this recommended study is expected to be moderate to high. The applicant did not propose any alternative studies in its PAD to address this specific issue.

Literature Cited

Fox, M. J.C. Graham, and S. Frank. 2009. Determining Adult Pacific Lamprey Abundance and Spawning Habitat in the Lower Dechutes River Sub-Basin, Oregon. Department of Natural Resources Confederated Tribes of the Warm Springs Reservation, Oregon

Fox, M. J.C. Graham, and S. Frank. 2010. Determining Adult Pacific Lamprey Abundance and Spawning Habitat in the Lower Dechutes River Sub-Basin, Oregon. Department of Natural Resources Confederated Tribes of the Warm Springs Reservation, Oregon

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Noyes, C.J., C.C. Caudill, T.S. Clabough, D.C. Joosten, E.L. Johnson, M.L. Keefer, and G.P. Naughton. 2011. Adult Pacific lamprey migration behavior and escapement in the Bonneville Reservoir and Lower Columbia River monitored using the juvenile salmonid acoustic telemetry system (JSATS). Technical Report 2012-4-Draft

Smith, S. J. and J. E. Marsden. 2009. Factors Affecting Sea Lamprey Egg Survival. North American Journal of Fisheries Management 29:859–868.

Study Request 30. Effects of the Wilder and Bellows Falls Projects on the Dwarf Wedgemussel (*Alasmidonta heterodon*)

Goals and Objectives

It has been well documented that the damming of rivers can have detrimental impacts on the mussel communities that inhabit areas both upstream and downstream of dams (Watters 1999, Layzer et. al. 1993, Moog 1993). The goal of this study is to evaluate the effects that the Wilder and Bellows Falls hydroelectric projects have on populations of the federally-endangered dwarf wedgemussel (*Alasmidonta heterodon*). In addition, the results of the study can be used to develop measures to minimize adverse impacts to the dwarf wedgemussel in the future. The specific objectives of the study are as follows:

Objective 1: Conduct an initial survey of the free flowing stretch of the Connecticut River from the Wilder Dam to the upstream end of the Bellows Falls impoundment to determine the distribution of the dwarf wedgemussel in this reach.

Objective 2: Determine the best sites for intensive quantitative sampling of mussel communities, with emphasis on the dwarf wedgemussel. Data will be collected to estimate density (mussels per unit area) and age class structure for all species.

Objective 3: Lay the groundwork for a long-term monitoring program.

Objective 4: Document instream behavior of mussels during varying flow conditions.

Objective 5: Determine how availability and persistence of dwarf wedgemussel habitat changes with water level and flow fluctuations.

Relevant Resource Management Goals and Public Interest Considerations

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish, wildlife, plants, and their habitats are important public resources. There is a strong public interest in protecting, conserving, and enhancing these resources for public benefit. It has been well documented that the damming of rivers can have detrimental impacts on the mussel communities that inhabit areas both upstream and downstream of dams (Watters 1999, Layzer et. al. 1993, Moog 1993). The goal of this study is to evaluate the effects that the Wilder and Bellows Falls hydroelectric projects have on populations of the federally-endangered dwarf wedgemussel (*Alasmidonta heterodon*).

Existing information

In 2011, Biodrawversity, LLC conducted a freshwater mussel survey throughout the Vernon, Bellows Falls, and Wilder project areas (Biodrawversity and LBG 2012). This survey was semi-quantitative (i.e. timed searches were used) and the main goal was to assess the distribution, abundance, demographics, and habitat of the dwarf wedgemussel in the project areas. Dwarf wedgemussel were found in the Wilder impoundment (all within a 14-mile stretch of the river beginning 27 miles upstream of the Wilder Dam) and Bellows Falls impoundment (located sporadically in the upper 17 miles of the impoundment); none were found in the Vernon project-affected area. These results corroborate the results of other studies performed in the past in these areas (Nedeau 2006a, Nedeau 2006b).

Need for additional information

The 2011 survey did not include the 17-mile free flowing stretch of the Connecticut River downstream of Wilder Dam. The dwarf wedgemussel has, in the past, been found within this river reach, although overall there has been limited survey work in the area. A better understanding of the distribution and abundance of the dwarf wedgemussel in this stretch of the river is required before an evaluation of how the dam affects this species can be made. **This need is represented in Objective 1**.

Since the 2011 survey was semi-quantitative, it cannot be used as a basis for determining population estimates or trends (Wicklow 2005). In fact, few if any of the past surveys performed in the project-affected areas have employed quantitative methodology. In addition, there is little quantitative information regarding the age class structure, and therefore recruitment, of the mussel communities in the area. In order to demonstrate that a dwarf wedgemussel population is viable according to the Dwarf Wedgemussel Recovery Plan (USFWS 1993), it must have a large and dense enough population to maintain genetic variability and annual recruitment must be adequate to maintain a stable population. Thus, knowledge of population size and density as well as a better understanding of age class structure is a necessary step in determining the baseline status of dwarf wedgemussel populations. The 2011 survey and other surveys can be used to determine the best sites for implementing a monitoring program. **This need is represented in Objective 2**.

Once this baseline is established, it will be important to monitor the sites so that biologists can estimate and track changes to dwarf wedgemussel populations and/or evaluate any project-related population impacts. Therefore, there is a need to develop long-term monitoring plots that will be surveyed at regular intervals using methodology that is repeatable and yields quantitative, statistically valid results. **This need is represented in Objective 3**.

Flow conditions that result from dam operations may alter the behavior of individual dwarf wedgemussels or individuals of other species. Dam operations affect streamflow, temperature, and dissolved oxygen, and changes to these variables can often be rapid. It is not known how these rapid changes affect various aspects of a mussel’s biology, including lure display, shell position (open/closed), siphoning rate, and vertical migration. **This need is represented in Objective 4**.

Dam operations can also affect the availability of habitat for mussels, and this availability can change quickly as water levels fluctuate under peaking operations. The persistence of habitat is a key element to the long-term success of sedentary lotic organisms such as the dwarf wedgemussel (Maloney et. al. 2012), which is unable to quickly move in response to rapid changes in its environment and can thus become stranded in areas of unsuitable habitat; however, there is currently no information concerning the relation of project operations to habitat persistence within the Wilder and Bellows project-affected areas. **This need is represented in Objective 5**.

Project Nexus

The dwarf wedgemussel is known to occur within the Wilder and Bellows Falls project areas and operations of these two dams may affect the viability of this species in the Connecticut River. This study plan will allow for a better understanding of how sub-daily flow and water level fluctuations influence dwarf wedgemussel abundance, available habitat, and behavior. This information can be used to inform the development of license requirements that can ensure the continued existence of this species within the project-affected areas.

Additionally, a long-term monitoring program of important dwarf wedgemussel sites within the project areas is necessary to evaluate any project-related population and/or behavioral impacts that may occur. This information can be used to inform decision makers in the future.

Proposed Methodology

A survey of the 17-mile reach between the Bellows Falls impoundment and the Wilder Dam is the logical first step of the study plan, and this can be done in well less than one field season. This may be treated as an extension of the Biodrawversity and LBG (2012) survey and the same semi-quantitative methodology may be used. Once completed, this survey will help fill in the knowledge gap that exists in the distribution of the dwarf wedgemussel within this reach of the Connecticut River. **This proposed methodology corresponds to Objective 1**.

Next, quantitative study plots should be established at sites throughout the two project-affected areas that are known to support the dwarf wedgemussel. Plots should be set up and surveyed using methodology that will allow for the estimation of population density and size. Smith et. al. (2001) have developed such a methodology, which is also outlined in Strayer and Smith (2003). It is based on a double-sampling design (visual inspection of the substrate surface plus excavation of a random subset of quadrats) using 0.25 m^2 quadrats that are placed systematically with multiple random starts. This protocol has been used to monitor dwarf wedgemussel populations at two sites on the Ashuelot River in Keene, NH (Nedeau 2004). A number of other recent studies have also made use of this protocol for different species of mussels (Fulton et. al. 2010, Crabtree & Smith 2009, Bradburn 2009).

Data to determine age class structure should also be collected at these selected sites. This would involve measuring the length and estimating the age (through external annuli counts) of each mussel sampled within a quadrat. Based on this information, an analysis of recruitment can be made. This field work and analysis was performed on the mussel community inhabiting the lower Osage River in Missouri as part of the relicensing process of the Osage Hydroelectric Project (FERC no. 459) (ESI 2003). The work done on the Osage can be used as a template for this study. Depending on how many plots are chosen, this phase of the study could take one or two field seasons. **This proposed methodology corresponds to Objective 2**.

The sites surveyed to meet Objective 2 should be resurveyed using the same methodology at regular intervals in the future so that any changes over time and/or over varied flow regimes can be evaluated. In addition, a mark-recapture pilot study should be initiated to evaluate the potential for using this methodology for long-term monitoring of dwarf wedgemussel abundance and survival. Mark-recapture methods provide statistically robust estimates of population parameters that are superior to simple count estimates in cases where it is not practicable to count all individuals in a population. Methods should be similar to those in Peterson et al. (2011), Meador et al. (2011), and Villella et al. (2004), but should focus on differences among sampled sites. Sites should be selected based on those sampled to meet Objective 2, but should also include sites outside of the project area to fully evaluate project effect and to account for any natural variability that may be independent of project effect.

A long-term mussel monitoring program was devised as part of the study plan for the relicensing of the Lake Blackshear Hydroelectric Project (FERC no. 659) on the Flint River in Georgia. According to the monitoring plan (Lake Blackshear Project 2009), three surveys will be conducted five years apart, beginning five years after issuance of the FERC license. Surveys will be quantitative (there is a qualitative aspect to the Lake Blackshear mussel monitoring plan that can be ignored) and will focus on evaluating changes in recruitment and population size of the purple bankclimber (*Elliptoideus sloatianus*), a federally-listed species. A similar protocol should be used to monitor dwarf wedgemussel populations in the project-affected areas of the Connecticut River post-license, although the number of surveys and the time between surveys may require some research and discussion. **This proposed methodology corresponds to Objective 3**.

In order to investigate the effects that the hydropower projects have on mussel behavior, individual mussels should be observed as flow fluctuates as a result of dam operations. Researchers should measure changes in shell position (open/closed), siphoning rate, lure display, horizontal migration (movement across the substrate), and vertical migration (burrowing). Past studies have quantified changes in vertical migration due to flow fluctuations (Saha & Layzer 2008, DiMaio & Corkum 1997). This phase of the study will likely take two field seasons in order to maximize the number of behavioral observations so that any trends can be identified and evaluated. **This proposed methodology corresponds to Objective 4**.

At these same sites, an evaluation of flow fluctuations on dwarf wedgemussel habitat persistence should be conducted following methods similar to those of Maloney et. al. (2012). This will include the development of a two-dimensional hydrodynamic model based on modeled depth, velocity, Froude number, shear velocity, and shear stress. This model will be used to quantify suitable dwarf wedgemussel habitat and its persistence over a range of flows, including flows typically experienced under peaking operations. These methods are being employed to evaluate persistence of dwarf wedgemussel habitat on the Delaware (Maloney et. al. 2012) and Susquehanna (T. Moburg, The Nature Conservancy, personal communication) rivers. Depending on how many plots are chosen, this phase of the study could take one or two field seasons. **This proposed methodology corresponds to Objective 5**.

Level of Effort and Cost

The cost for collecting the data for this study is entirely dependent on the number of study sites selected, as well as how frequently surveys will be conducted as part of the long-term monitoring plan. The expected level of effort and anticipated costs will be comparable to that of similar FERC relicensing projects of this size.

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Study Request 31. Project Effects on Populations of Tessellated Darter, *Etheostoma olmstedi*

Goals and Objectives

The goal of this study is to evaluate the effects of project operations on populations of tessellated darter (*Etheostoma olmstedi*), a New Hampshire species of greatest conservation concern and known host species for the federally-endangered dwarf wedgemussel (*Alasmidonta heterodon*). The specific objectives of the study are to:

1. Determine the distribution and abundance of tessellated darter within project-affected areas; and
2. Determine the effects of project operations on the distribution and abundance of tessellated darter.

Resource Management Goals

Not applicable, requester is not an agency or Indian tribe.

Public Interest Consideration

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. Fish, wildlife, plants, and their habitats are important public resources. There is a strong public interest in protecting, conserving, and enhancing these resources for public benefit. The goal of this study is to evaluate the effects of project operations on populations of tessellated darter (*Etheostoma olmstedi*), a New Hampshire species of greatest conservation concern and known host species for the federally-endangered dwarf wedgemussel (*Alasmidonta heterodon*).

Existing Information

In the Preliminary Application Documents (PADs)s for the Wilder, Bellows Falls, and Vernon projects, the applicant acknowledges that tessellated darter is one of the confirmed hosts of dwarf wedgemussel. It also identifies the occurrence of tessellated darter both upstream and downstream of each project. However, studies that specifically target small-bodied benthic species are lacking in project-affected areas. It is therefore likely that results of previous investigations are biased and underestimate true population size. An effective evaluation of project effects on a population will require robust, unbiased estimates of population parameters such as abundance or occupancy and similar estimates of population parameters under known conditions of low to no effect.

Existing literature indicates that tessellated darters may be found in a variety of habitats (Scott and Crossman 1979, Van Snik Gray and Stauffer 1999, Hartel 2002, Van Snik Gray et al. 2005, Henry and Grossman 2008), but these habitats are not necessarily equal in their ability to support the population or its function as host to dwarf wedgemussel. We cannot be certain that habitat use infers preference, nor that habitat use will be consistent from basin to basin. Therefore, habitat use within project-affected areas should be evaluated, and should be evaluated in concert with population parameters. By estimating population parameters (e.g., abundance, occupancy, extinction/colonization) as functions of habitat, we may determine whether habitat contributes to any differences in populations and if so, what specific habitat is preferred for stable and persistent populations.

Project Nexus

Operations at the Wilder, Bellows Falls, and Vernon projects alter natural river flow and consequently cause changes in the availability of instream habitat on which the tessellated darter and other lotic species depend. Habitat for tessellated darters is directly related to project operations in terms of flow (water depth and velocity, and their timing, duration, frequency, and rate of change) as well as the interactions of flow with other habitat variables such as substrata, vegetation, and cover. Operations both upstream (changes to the reservoir) and downstream (changes to the flow regime) may affect habitat, and may consequently lead to changes in the distribution, abundance, and behavior of tessellated darters that could in turn potentially affect the federally-endangered dwarf wedge mussel, for which the tessellated darter is a host species.

The information collected for this requested study will help determine whether project operations have a substantial effect on populations of tessellated darter, or whether population parameters are consistent with those of other populations in the region. If there is an effect of project operations on darter populations, study results will also permit identification of those habitat components related to operations that are most important for maintenance of stable and persistent populations of tessellated darter. This will in turn provide information that will assist the development of recommendations aimed to maintain populations of dwarf wedgemussel.

Proposed Methodology

Using an accepted and robust field sampling design (e.g., as described in Pollock et al. 2002 or MacKenzie et al. 2006) and accepted methods for collecting tessellated darters and other similar small-bodied fishes, conduct a field survey for tessellated darters within all project-affected areas from the headwaters of the Wilder pool downstream to the Vernon dam, as well as in selected areas outside of the project-affected areas with known stable populations of tessellated darter and/or dwarf wedgemussel. Such a sampling design should include replicate samples for estimation of species detection probability. For each replicate sample, collect and record data that may be important for describing differences in populations of tessellated darter, such as presence or abundance of other species (e.g., dwarf wedgemussel, slimy sculpin *Cottus cognatus*), depth, velocity, water temperature, substrata, time of day, presence of cover, proportion of vegetation cover, size of individuals collected (juveniles may select different habitat; larger individuals may outcompete smaller individuals for preferred habitat), and other factors as determined by a qualified biologist. Include also as covariates any relevant flow characteristics (Zimmerman 2006) that may differ among sites.

Using methods as described by Kery et al. (2005), MacKenzie et al. (2006), or Wenger and Freeman (2008), determine whether population estimates of tessellated darter are different in project-affected areas and, if so, which measured factors or flow characteristics are most important in describing these differences.

Level of Effort and Cost

The cost for collecting the data for this study is entirely dependent on the number of sites, number of sample replicates, and the extent of the covariate data that are measured, all of which and should be determined during the development of the study plan in consultation with fishery agencies and other parties, and may be adjusted during the course of field sampling. In general, if a species is common and easily captured, few replicates and many sites produce the best estimates, whereas more replicates and fewer sites are preferable for rare species. In general, the more replicates added, the lower the errors in detection probability, and the more sites sampled, the lower the errors in population parameters. The number of people required in the field will be dependent on the sampling method that is selected, but should be at least two individuals. Provided the collected data are of high quality, analysis and synthesis should take at most 5-10 days.

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FEDERAL ENERGY REGULATORY COMMISSION
Washington, DC 20426
March 1, 2013

OFFICE OF ENERGY PROJECTS

Project No. 1892-026 – New Hampshire / Vermont
Project No. 1855-045 – New Hampshire / Vermont
Project No. 1904-073 – New Hampshire / Vermont
TransCanada Hydro Northeast Inc.

Mr. John Ragonese
Relicensing Project Manager
TransCanada Hydro Northeast, Inc.
4 Park Street, Suite 402
Concord NH 03301
Telephone: (603) 498-2851

Subject: Identification of PAD Deficiencies, Additional Information Requests, and Study Requests

Dear Mr. Ragonese:

After reviewing the Wilder, Bellows Falls, and Vernon Hydroelectric projects Pre-Application Documents (PADs) and the transcripts of our scoping meetings held between Monday, January 28 and Thursday, January 31, 2013, we determined that there are some deficiencies in the PADs. We also determined that there is a need for additional information and study requests in order to gain information necessary for our preparation of environmental documents.

We identify the PAD deficiencies and existing additional information needs in the attached Schedule A, and we provide our study requests in the attached Schedule B. Please provide the deficiencies and additional information requested in Schedule A when you file your proposed study plans, on or before April 15, 2013. The last part of Schedule A includes comments on the PAD which should be used during the preparation of the Preliminary License Proposal (PLP) and/or the License Application. Please note that if you propose any plans for measures to mitigate project impacts, drafts of those plans should be filed with the PLP or draft license application and finalized and filed with the final license application.

Finally, please note that we may determine a need for additional studies or information upon receipt and review of scoping comments/study requests and study plans proposed by TransCanada Hydro Northeast, Inc. (TransCanada).

The Commission strongly encourages electronic filings via the Internet in lieu of paper. See 18 CFR § 385.2001(a)(1)(iii) and the instructions on the Commission's website (http://www.ferc.gov) under the "e-Filing" link.

Commission staff will participate in your study plan meeting(s), when scheduled. The meeting(s) will be held to discuss your proposed study plans and study requests filed by the Commission, agencies, and other parties. Interested individuals are encouraged to attend and should contact you at (603) 498-2851, or via email at john_ragonese@transcanada.com for the logistics.

If you have any questions, please contact Kenneth Hogan at (202) 502-8434 or via email at: kenneth.hogan@ferc.gov.

Sincerely,

Timothy J. Welch, Chief
West Branch
Division of Hydropower Licensing

Enclosures: Schedule A
Schedule B

cc: Mailing List
Public Files

PRE-APPLICATION DOCUMENT DEFICIENCIES, ADDITIONAL INFORMATION REQUESTS, AND COMMENTS

Based on our review of the Pre-Application Documents (PADs) submitted for the Wilder, Bellows Falls, and Vernon Hydroelectric projects, we identified: (a) some deficiencies in the PADs and; (b) additional information that we require for continuing to process the relicensing of the project. Please file the requested supplemental information to resolve the deficiencies and responses to the additional information requests (AIRs) by April 15, 2013.

A. Deficiencies

Our review of the PADs for the Wilder, Bellows Falls, and Vernon Projects found deficiencies common to each project. Therefore, **for each project**, please correct the PAD deficiencies outlined below.

<u>Wilder, Bellows Falls, and Vernon Hydroelectric Projects</u>

1) Project Facilities and Operations

Please provide land use maps which include key features such as the Wilder project boundary and TransCanada facilities within or adjacent to the impoundment as required per § 5.6(d)(2)(ii) of the regulations.

Please provide the dependable capacity of the Wilder project and the basis for the determination of the dependable capacity as required per § 5.6(d)(2)(iii)(E) of the regulations.

2) Geology, Topography & Soils

The PAD provides general information about soil types along the reservoir; however it does not provide maps. Therefore, please provide mapping at a usable scale showing the existing geology, topography, and soils along the reservoir as required by § 5.6(d)(3)(ii) of the regulations.

The PAD provides general information about erosion along the reservoir, however it does not provide descriptions and maps. Therefore, please provide a description of the reservoir shoreline erosion sites as required by § 5.6(d)(3)(ii)(C) of the regulations, including steepness, composition, cover, and a description of existing instability including a description of project operations that are known to, or may cause, these instabilities. In particular, we note the presence of a brownfield site at the Westboro Railyard, in West Lebanon, NH just below the confluence of the White River. The issues raised in the public meetings highlighted the potential for mobilization of contaminated materials or groundwater into the Connecticut River, exacerbated by the operation of the project. Therefore, when correcting the deficiency, please also include any additional information associated with this brownfield site and as it may pertain to this concern.

3) Recreation and Land Use

For each recreation facility within or adjacent to the project boundary, please provide a description of the facility, uses, location, ownership, capacity, and management, as specified in § 5.6(d)(3)(viii) of the regulations.

B. Additional Information Requests

<u>Wilder Hydroelectric Project</u>

1) Recreation and Land Use

Your PAD identifies several recreation sites and facilities that are in close proximity to one another and near project boundaries, particularly the area around Wilder Dam. Although Figure 3.10-1 provides a map of the Wilder project boundary and recreation sites, it is difficult to discern the exact location of these sites with respect to one another and whether each site is located within the project boundary. Please map this area in greater detail (i.e., larger scale) including the project boundary and recreation facilities as displayed in Figure 3.10-1.

When detailing recreation use estimates, the PAD references a TransCanada 2009 document in Section 3.10.3 that is not listed in the references. Recreation use estimates are critical for us to evaluate the current use, overall demand, and possible future use. Therefore, it is important for us to understand the methods and study design used to estimate these results. Please provide the reference for the document, methods of data collection, and an explanation of how use estimates were derived.

Throughout the scoping meetings, some stakeholders identified a concern with a lack of vegetative buffers between the reservoir shoreline and upland land management practices. So that we may fully understand the land use adjacent to the project reservoir and how project operations and maintenance may influence these adjacent uses, please provide any existing information and maps on land use and land classification for all lands within the project boundary, associated buffers, the authorized non-project use of project lands, and to the extent known, any lands immediately adjacent to the project boundary and within the floodplain. In addition to a general description, this information should include aerial photographs and local or regional planning agency land use classifications.

At the scoping meetings and during the site visit held on October 1, 2012, we learned that there are a number of shoreline activities that occur along the reservoir including shoreline development, docks, and farming. However, the PAD provides little information on shoreline management. The PAD states that the demand for docks has not required a formal permitting process or management. The PAD was also unclear about other TransCanada shoreline management practices. Please provide further explanation of TransCanada's shoreline management practices including the number of permits issued, standard permit conditions, clarification of New Hampshire state requirements for minimum shoreline buffer, and any other pertinent information related to shoreline management.

2) Cultural Resources

In section 3.12 of the PAD, you state that you conducted a Phase IA Archaeological Reconnaissance Survey to identify known archaeological sites within the project’s area of potential effects (APE) and to identify areas of archaeological sensitivity where documented and previously recorded archaeological sites are likely to exist. You also state that you have completed a study to identify historic standing structures within the Deerfield and Connecticut River hydroelectric systems to establish a baseline archival record and that documentation was completed to Historic American Engineering Record (HAER) standards. In section 4.10.2, you propose to conduct a cultural resources study that may include Phase IB Intensive Archaeological Investigations. You also propose to formally evaluate the National Register of Historic Places (National Register)-eligibility of the project facilities. However, you have not provided a map specifically defining the APE, and we are unclear on how you would specifically carry out the various tasks involving your proposed study.

As a result, we ask you to include the following in your study proposal for cultural resources:[1]

a) In section 3.12 of the PAD, you state that an APE for the project was defined in consultation with the Vermont and New Hampshire SHPOs. We ask that you provide documentation in your study proposal for cultural resources that the APE defined for the project would include all lands enclosed by the project boundary including both in-water and on-shore project lands and facilities, and lands or properties outside the project boundary where project operations or other project-related activities may directly or indirectly cause changes in the character or use of historic properties, if any historic properties exist. Your study proposal should also include a record of consultation with the Vermont and New Hampshire SHPOs and other interested parties regarding the APE or a proposal to complete such consultation as a component of the study.[2] Include a detailed map showing all aspects of the APE, including designations of land ownership.

b) Include the techniques on how you would carry out the Phase IB investigation, in addition to any other methods (if needed) by which other cultural resources that may be directly or indirectly affected by the project will be inventoried. Your proposal should include methods for inventorying all archaeological and historic resources that may lie within the APE, including project facilities, non-project architectural resources, and properties of traditional religious or cultural significance.

c) Develop and include in your study proposal a process for evaluating the National Register eligibility of all cultural resources during the field inventory stage, and afterwards, through additional second season field investigations (if necessary),[3] including a strategy for examining, testing, or

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[1] Include in your study proposal that you would also consult with the Vermont State Historic Preservation Officer (SHPO), the New Hampshire SHPO, and any involved Indian tribe or other interested parties in formulating each of the tasks listed below. Although there are no federally recognized Tribes in New Hampshire or Vermont, there are Native American organizations that may attach religious and cultural significance to historic properties in the APE.

[2] Once you have defined your APE, send your APE definition and APE map to the Vermont and New Hampshire SHPOs and seek their concurrence. The APE definition and map should be included in your study proposal, along with a record of consultation.

[3] If all National Register eligibility determinations cannot be done in either the first or

excavating cultural resources. This process should take into account applicable guidelines and standards promulgated by the Vermont and New Hampshire SHPOs.

d) Elaborate on what methods you would use to identify any existing project-related effects (both direct and indirect) on historic properties recorded during the field inventory, and determine how project operations may affect or potentially affect them.

e) Include in any study report: (1) a background section on previous work in and around the APE; (2) a culture history of the research area; (3) definition and map of the APE; (4) methods used for the archival research and field pedestrian survey and how the APE was systematically inventoried; (5) the results of the survey and detailed descriptions of the cultural resources found (including a table depicting type of cultural resources, age, property location and ownership, associated artifacts, existing and potential effects, and National Register eligibility status);[4] (6) results of National Register evaluations for all cultural resources located within the APE;[5] and (7) site or resource specific descriptions of existing and potential project-related effects on cultural resources considered to be eligible for inclusion in the National Register.

f) Put a statement in your study proposal you will also prepare a HPMP in consultation with the involved parties and will file a draft HPMP along with your preliminary licensing proposal, and a final HPMP with your final license application.[6] Among other things, the HPMP should provide site-

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second season of field investigations, a program to follow-up on completing all National Register eligibility determinations of properties located within the APE could be developed and included in the Historic Properties Management Plan (HPMP).

[4] Also integrate all of the existing cultural resources information you have already compiled and completed, as expressed in section 3.12.

[5] In consultation with the involved parties, once you have determined which cultural resources may, or may not be eligible for the National Register, submit your evaluations to the Vermont and New Hampshire SHPOs (as applicable) for concurrence.

[6] Note that once the Commission finds the HPMP to be final, we would attach it to a programmatic agreement and after noticing the Advisory Council on Historic Preservation, we would execute the programmatic agreement with the Vermont and New Hampshire SHPOs, if the Advisory Council on Historic Preservation declines to participate. Execution of the programmatic agreement would evidence that the Commission has resolved any potential adverse effects to historic properties involved with the proposed project.

specific measures to resolve any potential project-related adverse effect to historic properties located within the project's APE.[7]

g) Provide a schedule for carrying out all of the various tasks involving your study, including the filing of draft and final reports and HPMPs.

h) Provide estimated costs associated with the various tasks in your study, along with the costs of report production and crafting the HPMP.

<u>Bellows Falls Hydroelectric Project</u>

1) Project Facilities and Operations

On page 3-128 the PAD states the shoreline of the reservoir is 72 miles; however, on pages 2-24 and 3-18 it states it is 74 miles long. Therefore, so that we may fully understand and evaluate your proposal and determine the appropriate studies needed, please provide clarification regarding the length of the reservoir shoreline.

2) Recreation and Land Use

Your PAD identifies several recreation sites and facilities that are in close proximity to one another and near project boundaries, particularly the area around Bellows Falls Dam. Although Figure 3.10-1 provides a map of the Bellow Falls project boundary and recreation sites, it is difficult to discern the exact location of these sites with respect to one another and whether each site is located within the project boundary. Please map this area in greater detail (i.e., larger scale) including the project boundary and recreation facilities as displayed in Figure 3.10-1 and provide the same level of information for the Bellows Falls Project as outlined above for recreation, land use, and shoreline management for the Wilder Project under B 1).

3) Cultural Resources

In section 3.12 of the PAD, you state that you conducted a Phase IA Archaeological Reconnaissance Survey to identify known archaeological sites within the project's APE and to identify areas of archaeological sensitivity where documented and previously recorded archaeological sites are likely to exist. You also state that you've

[7] You should use the Guidelines for the Development of Historic Properties Management Plans for FERC Hydroelectric Projects, developed by the Advisory Council on Historic Preservation and Commission in May 2002.

completed a study to identify historic standing structures within the Deerfield and Connecticut River hydroelectric systems to establish a baseline archival record and that documentation was completed to HAER standards. In section 4.10.2 you propose to conduct a cultural resources study that may include Phase IB Intensive Archaeological Investigations. You also propose to formally evaluate the National Register-eligibility of the project's facilities. However, you have not provided a map specifically defining the APE, and we are unclear on how you would specifically carry out the various tasks involving your proposed study.

As a result, we ask you to include information in your study proposal for Bellows Falls cultural resources as outlined above for the Wilder Project under B 2).[8]

Vernon Hydroelectric Project

1) Recreation and Land Use

Your PAD identifies several recreation sites and facilities that are in close proximity to one another and near project boundaries, particularly the area around Vernon Dam. Although Figure 3.10-1 provides a map of the Vernon project boundary and recreation sites, it is difficult to discern the exact location of these sites with respect to one another and whether each site is located within the project boundary. Please map this area in greater detail (i.e., larger scale) including the project boundary and recreation facilities as displayed in Figure 3.10-1 and provide the same level of information for the Vernon Project as outlined above for recreation, land use, and shoreline management for the Wilder Project under B 1 above) .

C. Study Reports

Throughout each of the PADs, TransCanada refers to information from numerous studies it conducted prior to submittal of the PADs. These study reports were not yet available when the PADs were filed with the Commission on October 31, 2012. Additionally, the PADs reference several other documents that are not readily available

[8] Include in your study proposal that you would also consult with the Vermont State SHPO, the New Hampshire SHPO, and any involved Indian tribe or other interested parties in formulating each of the tasks listed below. Although there are no federally recognized Tribes in New Hampshire or Vermont, there are Native American organizations that may attach religious and cultural significance to historic properties in the APE.

to the Commission or the public. As such, we request that you file the following study reports and reference documents with the Commission:

Cherau, S. and B. O'Donnchadha. 2008. Phase IA archaeological Reconnaissance Survey, Vernon Hydroelectric Project (FERC No. 1904, Windham County, Vermont and Cheshire County, New Hampshire. Public Archaeology Laboratory, Pawtucket, RI. Submitted to TransCanada Northeast Hydro, Concord, NH.

Holmes, R.D., M.T. Mulhollard, and C.D. Hertiz. 1991. Archaeological Reconnaissance Survey for the Proposed Riverbank Erosion Control Study, Massachusetts, Vermont, and New Hampshire. University of Massachusetts, Archaeological Services Report. Submitted to Northeast Utilities, Hartford, CT.

Hubbard, Michael, Suzanne Cherau, Jenifer Elam, John Daly, and Ora Elquist. 2012. Phase IA Archaeological Reconnaissance Survey, Wilder Hydroelectric Project (FERC No. 1892), Windsor and Orange Counties, Vermont, and Grafton County, New Hampshire. Public Archaeology Laboratory, Pawtucket,RI.. Submitted to TransCanada Hydro Northeast, Inc. Concord, NH.

TransCanada and Normandeau Associates Inc. (Normandeau) water quality sampling data and reports.

TransCanada and Normandeau Associates Inc. (Normandeau) Jesup's milk vetch/Wilder flow and the RTE study reports.

In addition, during the January 29, 2013 scoping meeting, TransCanada noted that the geologic, geotechnical, seepage and stability study along the Vernon Neck had recently been completed. Please file the results of the geologic, geotechnical, seepage and stability study along the Vernon Neck study.

D. Additional Comments for Preliminary Licensing Proposal (PLP) and License Application

Based on our review of each PAD we have the following additional comments which can be used during your future preparation of the PLP and/or License Application.

Wilder, Bellows Falls and Vernon Hydroelectric Projects

While each PAD did provide descriptions of aesthetic and visual characteristics of the respective project dam and adjacent facilities as required by § 5.6(d)(3)(ix), there were few accompanying photos. So we may perform an analysis of project effects on aesthetic resources, when submitting your PLP for each project please provide additional photograph evidence from public areas such as recreation facilities, public roadways, and designated trails of project features including the dam, appurtenant facilities, and facilities in towns and villages.

Wilder Hydroelectric Project, Project No. 1892-026
Bellows Falls Hydroelectric Project, Project No. 1855-045
Vernon Hydroelectric Project, Project No. 1904-073
Schedule B

STUDY REQUESTS

After reviewing the information in the Pre-Application Document (PAD), we identified a gap between the information in the PAD and the information needed to assess project effects. The intent of the following studies is to fill the gap between existing and needed information. We recognize that there may be additional existing information that currently has not been identified and may be sufficient to address our information needs. As such, please note that we can further discuss the extent of the information gap, any additional existing information, and the relative scope of the requested studies at the study plan meeting(s). As required in section 5.9 of the Commission's regulations, we address the seven study request criteria for the following requested studies.

Study Request #1 - Water Level Fluctuation Study

Projects: Wilder, Bellows Falls, Vernon

<u>Goals and Objectives</u>

§5.9(b)(1) – *Describe the goals and objectives of each study proposal and the information to be obtained.*

The goal is to identify hourly reservoir elevations throughout the upstream and downstream reaches affected by the project in order to assess project effects on aquatic and terrestrial resources under current and proposed operation. Specifically the study should identify hourly water levels and flows within the upstream and downstream reaches under project operation conditions for the full range of inflows to inform an analysis of potential operational effects on geologic and soil resources, and an analysis of project related effects on aquatic resources and terrestrial resources.

§5.9(b)(2) – *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.*

Not applicable.

§5.9(b)(3) – *If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.*

The Federal Energy Regulatory Commission must decide whether to issue a new license to TransCanada for the projects. Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. In making its license decision, the Commission must equally consider the environmental, recreational, fish and wildlife, and other non-developmental values of the project, as well as power and developmental values. Any license issued shall be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses.

Project operations affect reservoir and tailrace water levels on an hourly basis (or finer increment), which may affect several environmental resources. Understanding the projects' influence on hourly water levels and flows within the Connecticut River is essential to understand the effect of project operations on these environmental resources; and therefore, is relevant to the Commission's public interest determination.

Background and Existing Information

§5.9(b)(4) – *Describe existing information concerning the subject of the study proposal, and the need for additional information*

The PAD provided general information about the magnitude of the licensed limits for water level fluctuation in the project reservoirs and referenced information on the hydrology, hydraulics, and erosion conditions along the river reach below the Vernon Project and above Turners Falls,. For instance, TransCanada cited an Army Corps of Engineers (USACE) *Report on Connecticut River Streambank Erosion Study, Massachusetts, New Hampshire and Vermont*.[9] This report looked at hydraulics and erosion along a 141 mile reach of the River from the Turners Falls dam to the headwaters of the Wilder Project.[10] TransCanada has recently conducted a river reconnaissance study[11] to document existing bank conditions within project impoundments. TransCanada proposes no further studies.

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[9] Simons, D.B., Andrew, J.W., Li, R.M., & Alawady, M.A. (1979). Connecticut River Streambank Erosion Study: Massachusetts, New Hampshire, and Vermont. Waltham, MA: US Army Corps of Engineers (USACE).

[10] We note that the USACE's report quantified multiple contributing factors to bank erosion, and summarized that the erosional forces on river banks due to the project operation fluctuation of water levels was 15 to 18 percent of the shear stress forces caused by the flowing water.

[11] Kleinschmidt, 2010, Lower Connecticut River Shoreline Survey Report, Prepared for TransCanada Hydro Northeast

While this information is available, it is insufficient to fully inform an analysis of the contributing factors for erosion along the projects' reservoirs and tailraces. For example, the USACE's study and corresponding report was completed in 1979 and while it considered the hydraulics of the Connecticut River at that time, the hydraulics have changed with alterations to the three projects' operations since 1979[12] and operational changes to upstream storage projects. Additionally, TransCanada's recent river reconnaissance study does not take river hydraulics and project operation into consideration and only reviewed and assessed the conditions of the streambanks along the impoundments.

TransCanada noted during the scoping meetings that normal fluctuations are generally lower than the licensed limits. However, the PAD did not provide information on the variability, rate of change or the frequency of fluctuation within the reservoirs or tailraces. The data from this study, and the other study requests herein, coupled with information in the PAD provide information to understand the effect of project operations on multiple environmental resources (e.g. geology and soils, aquatic resources, and terrestrial resources).

Project Nexus

§5.9(b)(5) – *Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.*

The applicant notes the project-related effects of water level fluctuations upon soils and geology resources in the PAD, as well the potential related impact to terrestrial and aquatic resources. Operation of projects in the "average daily" run of river mode results in the storage and release of water within the day, producing water level fluctuations throughout the reservoirs and tailraces. The fluctuation in water levels affects the soils along the reservoir through saturation and dewatering of the embankment materials, potentially increasing their susceptibility to erosion. It is understood from information in the PAD and information presented at the scoping meetings that the

[12] *See* Transcripts of Wilder Hydroelectric Project evening scoping meeting filed on January 28, 2013, and transcripts of the Vernon Hydroelectric Project morning scoping meeting filed on January 30, 2013.

fluctuations are at a maximum during low flow periods and lessen with increasing river flows up to station hydraulic capacity.

The information from this proposed study should provide the variations in water elevations and fluctuation rates for various project operations during a variety of inflow conditions, identifying the ranges of water level fluctuations rates and variability with inflow and location along the reservoir. The results of this study will be used along with information within the PAD, and the next three study requests to identify operation related effects on erosion. Additionally, this information would help inform an analysis of project related effects on aquatic resources and terrestrial resources.

Proposed Methodology

§5.8(b)(6) – *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.*

Conduct the fluctuation study using an unsteady one-dimensional hydraulic model such as HEC-RAS, using level loggers to verify in-situ measurements at multiple sites within each reservoir and tailrace. Collect cross sectional input data at locations along the reservoirs and tailraces, utilizing survey data scope from the study request #2.

Quantify water level fluctuations at reservoir erosion sites under various inflow conditions, including rates of elevation change, and changes to mean velocity in the reservoir.

Level of Effort and Cost

§5.9(b)(7) – *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

The estimated cost of the study is approximately $90,000. An alternative study using just the level loggers might capture the water level fluctuation data, but would not have the ability to identify the dynamic river flows or isolate the effects of upstream discharges to fluctuations at the upper limit of reservoir influences.

Study Request #2 – River Bank Transect Study

Projects: Wilder, Bellows Falls, Vernon

Goals and Objectives

§5.9(b)(1) – *Describe the goals and objectives of each study proposal and the information to be obtained.*

The goal of this study is to provide river bank survey data to monitor riverbank erosion at specific locations along each reservoir and tailrace. The survey sites should be selected at representative erosion sites along the tailwater and reservoir reaches with varying types of erosion to capture different soils, water level influences, and morphology. This survey data will also be useful as hydraulic model input data required as part of study request # 1. The survey will be performed at all river bank locations four times per year for two years, and may lead into longer term monitoring and reporting. The timing for the surveys will be immediately after high spring flows, early and late summer, and then in late fall.

§5.9(b)(2) – *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.*

Not applicable.

§5.9(b)(3) – *If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.*

The Federal Energy Regulatory Commission must decide whether to issue a new license to TransCanada for the Wilder, Bellows Falls, and Vernon projects in the Connecticut River. Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. In making its license decision, the Commission must equally consider the environmental, recreational, fish and wildlife, and other non-developmental values of the projects, as well as power and developmental values. Any license issued shall be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses.

Public comments during the January 28 -30, 2013 scoping meetings indicate a strong public interest in erosion and a belief that the rates of erosion have increased recently and since deregulation of the energy markets. The riverbank surveys should capture existing conditions at representative locations and support a quantitative comparison. This would ensure that the effect of project operations pertaining to this resource is considered in a reasoned way and is relevant to the Commission's public interest determination.

Background and Existing Information

§5.9(b)(4) – *Describe existing information concerning the subject of the study proposal, and the need for additional information*

TransCanada commissioned an erosion monitoring study in 2010 to document riverbank erosion along the project reservoirs and tailraces. No riverbank geometry is available for the erosion sites, nor an understanding of the trends or rates of erosion at each project. This study request should provide baseline information on the erosion and erosional changes throughout the study period.

Project Nexus

§5.9(b)(5) – *Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.*

Erosion is likely to occur whenever moving water intersect with lands, and is a natural process with potentially both beneficial and adverse affects. The PADs describes a daily run-of-river mode of operation that results in headwater and tailwater flow fluctuations, resulting in a fluctuation of water levels. As referenced in the PAD, the 1979 Simons report attributes water fluctuations to be a factor in erosion. However, erosion, in and of itself, is not necessarily an adverse impact; but areas of excessive erosion that are a direct result of project operations or that may be having an adverse effect on another resource is of concern. The potential resources that may be affected are aquatic, terrestrial, cultural, recreation, or socioeconomic.

This study would help identify riverbank geology and rates of erosional changes. Coupled with information from the other requested studies, this data would provide an understanding of project effects on erosion and would inform the need for and appropriateness of potential erosion control measures to be included in a new license.

Proposed Methodology

§5.8(b)(6) – *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.*

The survey should be performed at all locations four times per year for two years. Conduct surveys immediately after high spring flows, early and late summer, and then in late fall as follows:

1. Collect field survey data at each project along 10 sites (30 total) four times per year, for a two year period. Reference the survey location to project datum, both vertically and horizontally, and have permanent, recoverable control points. Extend survey locations from a point 50-feet upland from the top of bank to a wadeable depth into the water, and collect data at a sufficient density to accurately describe the slope geometry. This survey could be coupled with the input data requirements for study request #1, where the first survey collection might extend the survey transection completely across the river including the opposite bank as required for the hydraulic model input. Further field survey data collection can be confined to the upland area, riverbank and wadeable depths.

2. Collect additional survey data at the survey locations sites within 15 days of a significant high water event that exceeds the hydraulic capacity of the project(s) affected.

3. Provide a summary of the work scope, section morphology and changes, weather patterns, riverflows and levels, and quarterly comparisons of morphology changes and patterns in the study report.

Level of Effort and Cost

§5.9(b)(7) – *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

The study is expected to cost $91,000 for the two year study. This estimated cost includes approximately 60 hours of engineering support, 670 hours of survey and technician support, 30 hours of CAD/GIS support, 20 hours of office support, and $11,000 in expenses.

Study Request #3– Historical River Bank Position and Erosion

Projects: Wilder, Bellows Falls, Vernon

Goals and Objectives

§5.9(b)(1) – *Describe the goals and objectives of each study proposal and the information to be obtained.*

The goal of this study is to assess the historic erosion and river bank movement within the projects' boundary.

§5.9(b)(2) – *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.*

Not applicable.

§5.9(b)(3) – *If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.*

The Federal Energy Regulatory Commission must decide whether to issue a new license to TransCanada for the Wilder, Bellows Falls, and Vernon projects in the Connecticut River. Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. In making its license decision, the Commission must equally consider the environmental, recreational, fish and wildlife, and other non-developmental values of the projects, as well as power and developmental values. Any license issued shall be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses.

Public comments during the January 28 -30, 2013 scoping meetings indicate a strong public interest in erosion and a belief that the rates of erosion have increased recently and since deregulation of the energy markets. Documentation of historic riverbank information, surveys and photos would provide an opportunity to quantify or compare changes over an extended time period. This would ensure that the effect of project operations pertaining to this resource is considered in a reasoned way and is relevant to the Commission's public interest determination.

<u>Background and Existing Information</u>

§5.9(b)(4) – *Describe existing information concerning the subject of the study proposal, and the need for additional information*

Public comments indicate that erosion has resulted in the loss of land along the project boundaries; however, no qualitative or quantitative information describing the amounts of lost lands has yet been made available. A thorough review of the information listed below, or from other sources, may provide detailed insight into riverbank changes and location over time.

<u>Project Nexus</u>

§5.9(b)(5) – *Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.*

Erosion is likely to occur whenever moving water intersect with lands, and is a natural process with potentially both beneficial and adverse affects. The PADs describes a daily run-of-river mode of operation that results in impoundment and tailwater flow fluctuations, resulting in a fluctuation of water levels. As referenced in the PAD, the 1979 Simons report attributes water fluctuations to be a factor in erosion. However, erosion, in and of itself, is not necessarily an adverse impact; but areas of excessive erosion that are a direct result of project operations or that may be having an adverse effect on another resource is of concern. The potential resources that may be affected are aquatic, terrestrial, cultural, recreation, or socioeconomic.

This study would help identify riverbank erosion conditions observed over a longer time period, allowing a comparison of historic and present conditions. Coupled with information from the other requested studies, this data would provide an understanding of project effects on erosion and would inform the need for and appropriateness of potential erosion control measures to be included in a new license.

Proposed Methodology

§5.8(b)(6) – *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.*

1. Conduct a literature and document search at local towns and Registry of Deeds to identify historical information on river bank mapping and boundary surveys locating the edge of river.

2. Conduct research into available FEMA flood insurance studies for the project areas, where field surveys may have been conducted at key locations along the reservoir.

3. Conduct research into available aerial photographic records, such as available from the National Agriculture Imagery Program (NAIP) and NRCS (formerly Soil Conservation Service), which has aerial imagery dating back to the 1930's.

4. Conduct research on land purchases, easement agreements, and flowage agreements for the projects, where surveys or descriptions of the river bank positions may be detailed.

5. Conduct research on project records for original survey data or real estate data collected to define the reservoir rim and project boundaries.

6. Prepare a report, summarizing data sources and information acquired from the previous steps, qualify and quantify historic bank movement and erosion, and compare results to new survey data from study request #2.

Level of Effort and Cost

§5.9(b)(7) – *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

This study effort is estimated to be a $30,000 effort, estimated to require approximately 325 hours of total labor.

Study Request #4 – Riverbank Erosion Study

Projects: Wilder, Bellows Falls, Vernon

Goals and Objectives

§5.9(b)(1) – *Describe the goals and objectives of each study proposal and the information to be obtained.*

Perform bank shear assessments using methodology such as the tractive force method to assess erosion potential from natural and project operational effects at representative erosion sites along the projects' reservoirs and tailwater, specifically at river bank survey sites within study request #2 or other significant locations identified within the Study Plan meetings.

§5.9(b)(2) – *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.*

None.

§5.9(b)(3) – *If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.*

The Federal Energy Regulatory Commission must decide whether to issue a new license to TransCanada for the Wilder, Bellows Falls, and Vernon projects in the Connecticut River. Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. In making its license decision, the Commission must equally consider the environmental, recreational, fish and wildlife, and other non-developmental values of the projects, as well as power and developmental values. Any license issued shall be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses.

Public comments during the January 28 -30, 2013 scoping meetings indicate a strong public interest in erosion and a belief that the rates of erosion have increased recently and since deregulation of the energy markets. Computation of erosional forces at select locations along the river from natural flows and water levels influenced by project operations will help identify the influences of project operation on riverbank erosion. This would ensure that the effect of project operations on erosional forces from river flows and water level fluctuations is considered in a reasoned way and is relevant to the Commission’s public interest determination.

Background and Existing Information

§5.9(b)(4) – *Describe existing information concerning the subject of the study proposal, and the need for additional information*

The PAD describes erosional processes and summarizes findings from the 2010 shoreline survey and the USACE’s 1979 report that concluded project operations are not likely to be a significant contributor to erosion within the reservoir.[13] This report looked at hydraulics and erosion along a 141 mile reach of the River from the Turners Falls dam to the headwaters of the Wilder Project.[14] Additionally, TransCanada has recently conducted a river reconnaissance study to document existing bank conditions within project impoundments. [15] TransCanada proposes no further studies.

While this information is available, it is insufficient to fully inform an analysis of the contributing factors for erosion along the projects’ reservoirs and tailraces. For example, the USACE’s study and corresponding report was completed in 1979 and while

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[13] Simons, D.B., Andrews, J.W., Li, R.M., and Alawady, M.A. 1979. Connecticut River Streambank Erosion Study Massachusetts, New Hampshire, and Vermont. Prepared for USACE, New England Division.

[14] We note that the USACE’s report quantified multiple contributing factors to bank erosion, and summarized that the erosional forces on river banks due to the project operation fluctuation of water levels was 15 to 18 percent of the shear stress forces caused by the flowing water.

[15] Kleinschmidt, 2010, Lower Connecticut River Shoreline Survey Report, Prepared for TransCanada Hydro Northeast.

it considered the hydraulics of the Connecticut River at that time, the hydraulics have changed with alterations to the three projects' operations since 1979[16] and operational changes to upstream storage projects. Additionally, TransCanada's recent river reconnaissance study does not river hydraulics, morphology, or project operation, into consideration and only reviewed and assessed the erosional conditions of the streambank along the impoundments.

TransCanada noted during the scoping meetings that normal fluctuations are generally lower than the licensed limits. However, the PAD did not provide information on the variability, rate of change or the frequency of fluctuation within the reservoirs or tailraces. The data from this study, and the other study requests herein, coupled with information in the PAD provide information to understand the effect of project operations on multiple environmental resources (e.g. geology and soils, aquatic resources, and terrestrial resources).

Project Nexus

§5.9(b)(5) – *Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.*

Erosion is likely to occur whenever moving water intersect with lands, and is a natural process with potentially both beneficial and adverse affects. The PADs describe a daily run-of-river mode of operation that results in headwater and tailwater flow fluctuations, resulting in a fluctuation of water levels. As referenced in the PAD, the 1979 Simons report attributes water fluctuations to be a factor in erosion. However, erosion, in and of itself, is not necessarily an adverse impact; but areas of excessive erosion that are a direct result of project operations or that may be having an adverse effect on another resource is of concern. The potential resources that may be affected are aquatic, terrestrial, cultural, recreation, or socioeconomic.

This study would quantify the forces and riverflows expected to cause erosion of the riverbanks at select locations under both flood conditions and normal project

[16] *See* Transcripts of Wilder Hydroelectric Project evening scoping meeting filed on January 28, 2013, and transcripts of the Vernon Hydroelectric Project morning scoping meeting filed on January 30, 2013.

operational conditions. Coupled with information from the other requested studies, this data would provide an understanding of project effects on erosion and would inform the need for and appropriateness of potential erosion control measures to be included in a new license.

Proposed Methodology

§5.8(b)(6) – *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.*

Using generally accepted methods:

1. Gather soils information for the riverbank transect, referenced in study request #2.

2. Compute river depth and velocity at river bank locations using HEC-RAS software or acceptable substitute, referenced in study request #1.

3. Perform tractive force or shear stress analyses to identify the incipient motion for dominant particle sizes.

4. Assess soils stability during drawdown, considering excess pore pressures.

5. Correlate river flow, shear stress, and drawdown to establish a flow/shear stress relationship to quantify project influence on erosion potential. Prepare a report that summarizes the input data (soils, morphology, flows, fluctuations), methods of computations, and results, describing the contributing causes of erosion at the study sites.

Level of Effort and Cost

§5.9(b)(7) – *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

The estimated cost of this work is approximately $66,000, would rely on data generated in other study requests and may be completed within one year.

It is anticipated that two technicians and an engineer would spend approximately 570 hours to conduct the study and prepare the report.

Study Request #5 – Aquatic Habitat Mapping

Projects: Wilder, Bellows Falls, Vernon

Goals and Objectives

§5.9(b)(1) – *Describe the goals and objectives of each study proposal and the information to be obtained.*

The goal of this study is to map the aquatic habitat at the Wilder, Bellows Falls, and Vernon projects in the Connecticut River, to evaluate the types of aquatic habitats that occur throughout the project areas (and downstream riverine corridors), and identify any potential project effects under current operations. Specifically, the objectives of the study are to:

1. Survey and map the aquatic habitat types distributed within the project impoundments, tailwaters, and downstream riverine corridors outside of the project areas in the Connecticut River from the upper extent of the Wilder impoundment and downstream to the upper extent of the Turners Falls Project's impoundment, including the Bellows Falls bypassed reach.

2. Describe the potential influences of the project reservoirs, water quality conditions, and project operations on the distribution of aquatic habitat within the reaches of the river evaluated.

§5.9(b)(2) – *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.*

Not applicable.

§5.9(b)(3) – *If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.*

The Federal Energy Regulatory Commission must decide whether to issue a new license to TransCanada for the Wilder, Bellows Falls, and Vernon projects in the Connecticut River. Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. In making its license decision, the Commission must equally consider the environmental, recreational, fish and wildlife, and other non-developmental values of the projects, as well as power and developmental values. Any license issued shall be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses.

Aquatic habitats in the Connecticut River support a sustainable riverine ecosystem that provides public opportunities, including a sport fishery. Ensuring that the effect of project operations pertaining to this resource is considered in a reasoned way is relevant to the Commission's public interest determination.

Background and Existing Information

§5.9(b)(4) – *Describe existing information concerning the subject of the study proposal, and the need for additional information.*

Review of TransCanada's PADs, as well as a preliminary review of scientific literature revealed minimal information pertaining to aquatic habitat resources within the projects reaches in the Connecticut River. Sparse site-specific data are provided in the PAD. Additional aquatic habitat information, including the mapped locations of aquatic habitats is needed to evaluate the projects effects on this resource.

<u>Project Nexus</u>

§5.9(b)(5) – *Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.*

Currently, water levels in the impoundments, tailwaters, and downstream riverine areas fluctuate due to the current peaking operations of all three projects. In addition, there is no minimum flow requirement in the bypassed reach at the Bellows Falls project. As a result, any aquatic habitat exposed under low flow conditions may be adversely effected and/or inhibit the utilization of aquatic habitats by aquatic species during various life stages. These events may also cause fish or other aquatic species (e.g., mussels and macroinvertebrates) stranding and associated mortality.

This requested study would help establish a baseline condition and the health of the aquatic habitat and aquatic species of the Connecticut River from the head of the Wilder impoundment to the head of the Turners Falls impoundment under current operations. These data would also assist in forming the basis for inclusion of potential license articles to protect aquatic resources in the Connecticut River.

<u>Proposed Methodology</u>

§5.8(b)(6) – *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.*

Using generally accepted practices in the scientific community:

1. Conduct field surveys during the low flow season (i.e. summer months) from the head of the Wilder project impoundment to the head of the Turners Falls Project impoundment, including within the Bellows Falls bypassed reach. Include all three project impoundments, tailwaters, and downstream riverine corridors.

2. Categorize the habitat survey information per accepted practices in the scientific community (e.g., riverine habitat type, substrate type, depths, etc.)

and plot on aerial maps. Record in-situ water quality conditions (temperature, DO, pH, conductivity).

3. Prepare a report that includes a summary of the data collected. The report should include aerial habitat maps, habitat descriptions, project operations and flow conditions during the survey, and in-situ water quality data. Include all data used to develop the report within an appendix to the report.

Level of Effort and Cost

§5.9(b)(7) – *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

The estimated cost of this work is approximately between $115,000, and may be completed within one study season.

It is anticipated that two technicians and a biologist would spend about 120 hours to conduct field work. Report preparation would require about 3 weeks by a biologist, and by GIS specialist.

Study Request #6 – Aquatic Habitat Instream Flow Study

Projects: Wilder, Bellows Falls, Vernon

Goals and Objectives

§5.9(b)(1) – *Describe the goals and objectives of each study proposal and the information to be obtained.*

The goal of this study is to evaluate the condition of aquatic habitat downstream of the Wilder, Bellows Falls, and Vernon dams (including the Bellows Falls bypassed reach) in the Connecticut River under flow conditions affected by project operations. Specifically, the objective of the study is to assess various stream flow conditions and resultant habitat for the production and survival of aquatic species downstream of the Wilder, Bellows Falls, and Vernon dams (including the Bellows Falls bypassed reach).

§5.9(b)(2) – *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resources to be studied.*

Not applicable.

§5.9(b)(3) – *If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study*.

The Federal Energy Regulatory Commission must decide whether to issue a new license to TransCanada for the Wilder, Bellows Falls, and Vernon projects. Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. In making its license decision, the Commission must equally consider the environmental, recreational, fish and wildlife, and other non-developmental values of the projects, as well as power and developmental values. Any license issued shall be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses.

Aquatic habitats and the species that utilize these habitats in the Connecticut River support a sustainable riverine ecosystem that is critical in providing public opportunities, such as the sport fishery. Ensuring that the effect of project operations pertaining to this resource is considered in a reasoned way is relevant to the Commission's public interest determination.

<u>Background and Existing Information</u>

§5.9(b)(4) – *Describe existing information concerning the subject of the study proposal and the need for additional information.*

Review of TransCanada's PADs, as well as a preliminary review of scientific literature revealed minimal information pertaining to the adequacy and/or availability of flow dependent aquatic habitats downstream of the projects. Additional information on in stream flow downstream of the three dams and bypassed reach at Bellows Falls is needed to evaluate the projects effects on fish and aquatic resources.

Project Nexus

§5.9(b)(5) – *Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.*

The Wilder, Bellows Falls, and Vernon projects operate as peaking hydroelectric projects. These peaking operations result in stream flow fluctuations of varying degrees based on total river flows and electricity demands. Because the projects reduce downstream flows when holding water in the project's reservoirs, there is a direct effect on the quantity and quality of the aquatic habitats downstream of the project dams. These effects could affect spawning, rearing, feeding, migration, and overwintering of aquatic species and may even cause stranding and mortality of aquatic species.

This requested study would help establish appropriate data of the effects of various flows on supporting aquatic habitat and species under current operations. These data would also assist in forming the basis for inclusion of potential license requirements (e.g. minimum instream flow) to protect aquatic resources in the Connecticut River.

Proposed Methodology

§5.9(b)(6) – *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge*.

Using generally accepted practices in the scientific community:

1. Use habitat mapping information of the Connecticut River downstream of the Wilder, Bellows Falls, and Vernon dams (including the Bellows Falls bypassed reach) as baseline habitat information in this study;

2. Conduct a substrate embeddedness evaluation in the study areas;

3. Consult with stakeholders to develop a specific methodology for evaluating instream flows within the project's hydraulic control at the three projects;

4. Establish a protocol for identifying or developing Habitat Suitability Curves for target species (if appropriate); and

5. Prepare a report that includes a summary of the data collected. The report should include aerial habitat maps, habitat descriptions, project operations and flow conditions during the study, and all other results from the study.

Level of Effort and Cost

§5.9(b)(7) – *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

The estimated cost of this work is approximately $200,000 and may be completed within one study season.

It is anticipated that two technicians and a biologist would spend about 130 hours to conduct field work for each project. Report preparation would require about 2 weeks by a biologist and technician for each project.

Study Request #7 – Baseline Fisheries Population Study

Projects: Wilder, Bellows Falls, Vernon

Goals and Objectives

§5.9(b)(1) – *Describe the goals and objectives of each study proposal and the information to be obtained.*

The goal of this study is to gather baseline fisheries data upstream and downstream of the Wilder, Bellows Falls, and Vernon projects in the Connecticut River. These data are needed to identify the fish species that occur in the projects' impoundments, tailwaters, the downstream riverine corridors, and the Bellows Falls bypassed reach and to evaluate any potential project effects. Specifically, the objectives of the study are to:

1. Determine the relative abundance and distribution of resident/riverine and diadromous fish species within the project impoundments, tailwaters, and downstream riverine corridors outside of the project areas in the

Connecticut River from the upper extent of the Wilder impoundment and downstream to the upper extent of the Turners Falls Project impoundment, including the Bellows Falls bypassed reach.

2. Describe the distribution of resident/riverine and diadromous fish species within the reaches of the river and in relationship to data gathered by the Aquatic Mapping Study.

§5.9(b)(2) – *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.*

Not applicable.

§5.9(b)(3) – *If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.*

The Federal Energy Regulatory Commission must decide whether to issue a new license to TransCanada for the Wilder, Bellows Falls, and Vernon projects. Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. In making its license decision, the Commission must equally consider the environmental, recreational, fish and wildlife, and other non-developmental values of the projects, as well as power and developmental values. Any license issued shall be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses.

Fish populations in the Connecticut River support a sport fishery. The effect of project operation on this resource is relevant to the Commission's public interest determination.

<u>Background and Existing Information</u>

§5.9(b)(4) – *Describe existing information concerning the subject of the study proposal, and the need for additional information.*

Review of TransCanada's PADs, as well as a preliminary review of scientific literature revealed minimal information on fisheries resources in the Connecticut River potentially affected by the project. While sparse site-specific data on general species presence and absence are provided in the PAD, additional fisheries population data are needed to evaluate the projects effects on this resource.

Project Nexus

§5.9(b)(5) – *Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.*

Potential project effects on fishery resources may include fish entrainment through the generating units, minimum instream flows, and peaking flow operations. Information on the abundance and distribution of the existing fish community would help to identify whether adverse effects are occurring.

The applicant is proposing to continue providing the existing minimum flows. Flow releases from the projects have the potential to affect the suitability of aquatic habitat in these reaches, and in turn fishery resources. This requested study would help establish a baseline condition on the health of the fishery of the Connecticut River in the projects' vicinity under current operations. These data would also assist in informing potential license articles to protect fishery resources in the Connecticut River.

Proposed Methodology

§5.8(b)(6) – *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.*

Using generally accepted practices in the scientific community:

1. Conduct electrofishing surveys in each of the project impoundments, tailwaters, and downstream riverine corridors, including boat or backpack electrofishing within the Bellows Falls bypassed reach. Conduct sampling during late-summer or fall in order to observe annual juvenile production (juvenile fish would be large enough to collect). Establish sampling locations that represent the full extent and types of habitat in the study area.

2. Separately target upstream and downstream migrating American eels for sampling using generally accepted methods, such as electrofishing, trap/fyke netting, eel pots, etc. to provide data on the abundance of American eels at various life stages, and where they tend to congregate at each of the projects. Conduct the study in late spring/early summer to target upstream migration juvenile eels (i.e., elvers and yellow eels), and during the fall to target downstream migrating adults eels (i.e. silver eels).

3. Identify to species and count all collected fish while weighing and measuring only a subsample. Measure eye diameters of captured American eels for use in the evaluating silver eels phase. Identify and record the habitat type and substrate of each sampling location , and record in-situ water quality conditions (temperature, DO, pH, conductivity).

4. Prepare a report that includes a summary of the data from the above studies. Include tabular summaries of fish species collected by station, plus data on lengths, weights, condition factors, and in-situ habitat conditions. Also include specific information relating to American eel populations characteristics , such as areas at the base of the dams where elvers congregate, and the abundance of potentially downstream migrating silver eels. Include all data used to develop the report (including date and time of collection) within an appendix to the report.

<u>Level of Effort and Cost</u>

§5.9(b)(7) – *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

The estimated cost of this work is approximately $100,000 and may be completed within one study season.

It is anticipated that three technicians and a biologist would spend about 165 hours to conduct field work for each project. Report preparation would require about 4 weeks by a biologist.

Study Request #8 – Assessment of Fish Impingement, Entrainment, and Survival Study

Projects: Wilder, Bellows Falls, Vernon

Goals and Objectives

§5.9(b)(1) – *Describe the goals and objectives of each study proposal and the information to be obtained.*

The goal of this study is to use the data gathered from the baseline fisheries population study to assess fish trashrack impingement, turbine entrainment, and survival at the Wilder, Bellows Falls, and Vernon projects in the Connecticut River. This information would be used to evaluate the effects from passage through project turbines and other passage routes on fish populations that occur throughout the project areas. Specifically, the objectives of the study are to:

1. Describe the physical characteristics of the Wilder, Bellows Falls, and Vernon projects that may influence fish impingement and entrainment rates, including intake location and dimensions, the velocity distribution in front of the intake structure, and the clear spacing between the trashrack bars;

2. Identify current and any future routes for fish movement past the three dams, and the risks of injury or mortality for each, taking into consideration seasonality of movement, flow direction and velocity, and current and future flow management regimes;

3. Analyze target species (i.e., individual species and guilds/groups) for factors that may influence their vulnerability to entrainment and mortality;

4. Assess the potential for target fish species impingement;

5. Estimate entrainment rates and numbers for target fish species;

6. Estimate turbine passage survival rates and numbers for target fish species;

7. Estimate total project survival considering all passage routes for American shad and river herring at the Vernon project; and

8. Estimate total project survival considering all passage routes for American eel, Atlantic salmon, and sea lamprey at the Wilder, Bellows Falls, and Vernon projects.

§5.9(b)(2) – *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.*

Not applicable.

§5.9(b)(3) – *If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.*

The Federal Energy Regulatory Commission must decide whether to issue a new license to TransCanada for the Wilder, Bellows Falls, and Vernon projects in the Connecticut River. Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. In making its license decision, the Commission must equally consider the environmental, recreational, fish and wildlife, and other non-developmental values of the projects, as well as power and developmental values. Any license issued shall be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses.

Fish populations in the Connecticut River support a sustainable riverine ecosystem that is critical in providing public opportunities, such as the important sport fishery. Ensuring that the effect of project operations pertaining to this resource is considered in a reasoned way is relevant to the Commission's public interest determination.

<u>Background and Existing Information</u>

§5.9(b)(4) – *Describe existing information concerning the subject of the study proposal, and the need for additional information.*

Review of TransCanada's PADs, as well as a preliminary review of scientific literature revealed no information pertaining to fish impingement, entrainment, and survival at the Wilder, Bellows Falls, and Vernon projects on the Connecticut River. Additional up-to-date information on fish impingement, entrainment, and survival is needed to evaluate the projects effects on this resource.

Project Nexus

§5.9(b)(5) – *Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.*

Potential t effects of project operations and facilities include fish impingement on the trashracks and entrainment through the generating units. Any fish moving downstream as a part of their life cycle would encounter a series of dams and intakes at hydroelectric projects in the Connecticut River, potentially resulting in exposure of these fish to multiple sources of mortality. Information pertaining to these effects would help identify any adverse effects from the projects.

This requested study would help establish a baseline condition and be considered when evaluating the health of the fishery of the Connecticut River in the project reach. These data would also assist in forming the basis for inclusion of potential license conditions to protect fishery resources in the Connecticut River.

Proposed Methodology

§5.8(b)(6) – *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.*

Using generally accepted practices in the scientific community:

1. Utilize the fish population data to develop a target species list that represents species of conservation interest and all fish guilds/groups in consultation with the state fishery resource agencies.

2. Conduct an assessment on the probability of trashrack impingement a the three projects considering the site-specific variables at each project, such as clear spacing, intake configurations, flow velocities, fish size, fish swim speeds, and life histories.

3. Conduct a literature review of entrainment studies conducted at other hydroelectric facilities, including the EPRI (1997)[17] database to derive entrainment rates for the target species at the Wilder, Bellows Falls, and Vernon projects. Correlate entrainment rates with flow through the units of each project and the relative abundance of each target species to estimate the levels of entrainment for each target species.

4. Using the site-specific specifications from each of the projects, conduct a blade strike assessment to derive survival rates of each target species. Correlate these survival rates with the entrainment estimates to estimate fish survival through the turbines of each of the two projects.

5. Use flow distributions through the projects turbines and other passage routes, as well as survival rates through alternative passage routes to estimate total project survival of migratory species at each of the project.

6. Prepare a report that includes a summary of the results from the assessments described above. Include all data used to develop the report in an appendix.

<u>Level of Effort and Cost</u>

§5.9(b)(7) – *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

The estimated cost of this work is approximately $65,000. It is anticipated that a biologist and a hydrologist would spend approximately 500 hours total to conduct the impingement, entrainment, and survival assessments and prepare a report.

[17] Electric Power Research Institute (EPRI). 1997. Turbine survival and entrainment database – Field tests. EPRI Report No. TR-108630. Prepared by Alden Research Laboratory, Inc. Holden, MA.

Study Request #9 – American Shad Upstream Migration and Behavioral Study

Projects: Bellows Falls & Vernon

Goals and Objectives

§5.9(b)(1) – *Describe the goals and objectives of each study proposal and the information to be obtained.*

The goal of this study is to track adult American shad within the Connecticut River, through inter-project riverine reaches, project reservoirs, and project facilities located within the species' historic range. These migration data would be correlated to project operations (e.g. flow), water quality, and any other parameters believed to influence migration behavior. This data would be used to evaluate the effects the hydroelectric projects operations and facilities on upstream American shad passage in the Connecticut River. Specifically, the objectives of the study are to:

1. Collect and tag upstream migrating adult American shad downstream of the projects to track their migration and behavior.

2. Identify any project operations and facilities contributing to migration delay, mortality, increased predation, upstream passage avoidance, or any other project related factors contributing to alterations in natural upstream migration and behavior.

§5.9(b)(2) – *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.*

Not applicable.

§5.9(b)(3) – *If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.*

The Federal Energy Regulatory Commission must decide whether to issue a new license to TransCanada for the Wilder, Bellows Falls, and Vernon projects in the Connecticut River. Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. In making its license decision, the Commission must equally consider the environmental, recreational, fish and wildlife, and other non-developmental values of the projects, as well as power and developmental values. Any license issued shall be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses.

American shad populations in the Connecticut River represent a valuable aquatic resource to the region, as well as a recreational and cultural resource. Identifying effects of project operations pertaining to this resource is relevant to the Commission's public interest determination.

Background and Existing Information

§5.9(b)(4) – *Describe existing information concerning the subject of the study proposal, and the need for additional information*

Review of FirstLight's PADs, as well as a preliminary review of scientific literature revealed sparse and dated information pertaining to upstream American shad migration and behavior on the Connecticut River. Although fish passage efficiency studies have been conducted within the passage facilities themselves, we are not aware of any studies on the potential effects of project operations on the migration efficiency of shad in the general project vicinity. Therefore, additional information on adult American shad migration and behavior is needed to evaluate the projects effects on this resource.

Project Nexus

§5.9(b)(5) – *Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.*

Potential effects of project operations at the Vernon and Bellows Falls projects may influence adult American shad migration and behavior in the Connecticut River. Any adult shad moving upstream would be exposed to a series of dams and unnatural flow conditions, potentially resulting in migration delay, increased predation, and other project related effects. Information pertaining to these effects would help identify if adverse effects from the projects are occurring.

This requested study would help identify any project-specific conditions adversely affecting upstream American shad passage conditions in the Connecticut River. These data would also assist in forming the basis for inclusion of potential license articles to protect adult American shad.

Proposed Methodology

§5.8(b)(6) – *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.*

Using generally accepted practices in the scientific community:

1. Capture upstream migrating adult American shad downstream of the projects during their upstream migration season. Insert telemetry tags into the captured American shad and record biological data before release and track their upstream migration and behavior, especially as these fish approach hydroelectric facilities. Closely monitor behavior of these shad as they approach and ascend fishways, as well as behavior within the projects impoundments.

2. Prepare a report that includes a summary of the results of the collected telemetry data. Include statistically justifiable analyses of American shad migration and behavior throughout the study area in the Connecticut River, and consider collected biological information, water quality data, river conditions, project operations and flow conditions, and the condition of project facilities during the time of the study. Also include graphics displaying the tagged-shad movements during the study. Include all data used to develop the report in an appendix.

Level of Effort and Cost

§5.9(b)(7) – *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

The estimated cost of this work is approximately $200,000. It is anticipated that a few technicians and a biologist would spend approximately 200 hours to conduct the field work and report. This study should be conducted over two seasons.

Study Request #10 – Recreation Facility Inventory and Use & Needs Assessment

Projects: Wilder, Bellows Falls, Vernon

Goals and Objectives

§5.9(b)(1) – *Describe the goals and objectives of each study proposal and the information to be obtained.*

The goals of the Recreation Facility Inventory and Use & Needs Assessment Study are to: (1) obtain information about the condition of existing recreation facilities and access sites at the projects; and existing recreation use, access, and demand at the projects; (2) conduct an assessment of the need to enhance recreation opportunities and access at the project; and (3) develop a Recreation Management Plan for the implementation of any enhancement measures and long-term monitoring of recreation demand and adequacy of facilities at the project over the term of a new license.

§5.9(b)(2) – *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.*

Not applicable.

§5.9(b)(3) – *If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.*

The Federal Energy Regulatory Commission must decide whether to issue a license to TransCanada for the Wilder, Bellows Falls, and Vernon Hydroelectric projects. Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. In making its license decision, the Commission must equally consider the environmental, recreational, fish and wildlife, and other non-developmental values of the project, as well as power and developmental values. Any license issued shall be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses.

Recreation has been identified as a legitimate project purpose by the Commission. Applicants are encouraged to develop recreation resources in such a matter that is "consistent with the needs of the area to the extent that such development is not inconsistent with the primary purpose of the project" (18 C.F.R. §2.7). Identifying effects of project operations pertaining to this resource is relevant to the Commission's public interest determination.

Background and Existing Information

§5.9(b)(4) – *Describe existing information concerning the subject of the study proposal, and the need for additional information.*

Section 3.10.3 of the PADs for each project provides a summary of FERC Form 80 Recreation Use Report annual visitation estimates for 2008. Section 3.10.2 provides a general description of public recreation facilities, activities, and demand at the projects. However, the PADs provide no detailed information regarding the condition of existing facilities or type or location of various uses. The PAD provides no project-specific information regarding visitor perceptions and identified needs at the projects. Information on current use and whether existing access facilities in the area are meeting recreation demand would inform a decision on whether additional, designated public access at the projects is necessary to meet existing and future recreation demand at the projects.

Project Nexus

§5.9(b)(5) – *Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.*

The projects include reservoirs, tailwater areas, and a bypassed reach at Bellows Falls, that are inherently attractive recreation features. An analysis of existing recreation use and access at the projects would help form the basis for determining the project's ability to enhance public recreation access opportunities. Also, an assessment of the current level of recreation use would provide information necessary to develop a Recreation Management Plan for efficient management of the recreational components of the project over the term of a new license.

Proposed Methodology

§5.8(b)(6) – *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.*

1. An assessment of the condition of existing developed recreation facilities should be conducted throughout the project using physical and visual inspections.

2. At Bellows Falls, the facility inventory should include characterization of the suitability of the bypassed reach for whitewater boating (e.g., gradient, length, character of potential flows) and the feasibility of incorporating a shorter and safer (i.e., a path that reduces boaters proximity and time near a highway) around Bellow Falls dam.

3. The use and needs assessment will include all recreation activity types known to occur or potentially occurring at the project. Methods should include visitor observations; on-site visitor intercept surveys at formal and informal public recreation areas at the project reservoirs, tailraces, and riverine areas, including the Bellow Falls bypassed reach; and mail and/or internet surveys targeting unique stakeholder groups that may not be practically accessed through on-site surveys (e.g., adjacent residential land owners, residents of the counties in which the projects are located, rock climbers, whitewater boaters).

4. Specific methods for each sampling approach in the use and needs assessment include: (1) the visitor observations should capture information such as location, date, time, weather, number of vehicles, watercraft (if any), number of recreation users or party size, and recreation activity engaged in; (2) the methodology for the visitor survey sampling will be based on a stratified random sample that includes all seasons, various locations, and various times of week and day to enable representative

responses from the visitors, while ensuring interview coverage during key times (e.g., holiday and weekend days, shoulder seasons, hunting seasons) (Note: surveys of fisherman and hunters should include additional pertinent information related to game and harvest); (3) the mail back survey will follow the Dillman Method or modified Dillman method, and include items such as frequency and duration of visits to the projects, qualitative ratings of existing public access and recreation facilities of the project area, and reasons for visiting or not visiting the projects for recreation

5. The needs assessment will include the demand for whitewater boating in the bypassed reach of Bellow Falls, existing boating opportunities within the project region (including at the project impoundments and immediately downstream of the project), feasibility of providing additional public access at the project reservoir and riverine reaches (potential locations, type of facilities and access, and any associated costs), identifying visitor perceptions regarding the adequacy of recreation facilities, and access in the project area, and assessing future recreation demand and facility needs at the project.

6. Quantify annual recreation use by activity type and season, to include, at a minimum, the project tailraces and Connecticut River Water Trail campsites, and the following locations:

    a. At the Wilder Project: Norwich Landing; East Wilder Boat Launch; Hartford (Wilder) Picnic Area at Kilowatt Park; Wilder Dam (Olcott Falls) Boat Launch; Fishladder and Angler Parking; Lebanon (Wilder Dam) Picnic Area, Vista, and hiking trails; Wilder Dam Portage and downstream natural areas.

    b. At the Bellows Falls Project: Charlestown Boat Launch and Picnic Area, Herrick's Cove Boat Launch and Picnic Area, Pine Street Boat Launch and Portage Trail Take-Out, Bellow Falls Fish Ladder Visitor Center, Bellows Falls Dam Portage Put-In, and the bypassed reach.

    c. At the Vernon Project: Fisherman Access Area; Vernon Canoe Portage, Vernon (Governor Hunt) Recreation Area & Boat Launch, and Vernon Neck Open Space.

7. Assess visitor perceptions of the effects of project operations and management on recreation and recreation opportunities at the project including fluctuating reservoir levels, minimum flow releases, and anticipated changes over a new license term. Identify potential measures to alleviate any negative effects as well as to enhance existing recreation opportunities and access.

8. A Recreation Management Plan for the projects should be included in the license application and should include, at a minimum: (1) description of any proposed protection, mitigation, and enhancement measures, including: location of any proposed facilities and/or access areas (including description and figure depicting the relationship of any proposed facilities to the existing project boundaries), proposed ownership and management of any proposed facilities, associated capital, and operation and maintenance costs; and a timeline for implementation; (2) description of operation and management measures associated with project-related recreation access and facilities; and (3) description of measures for future monitoring of recreation demand and adequacy of project-related facilities to meet this demand over the term of new licenses.

<u>Level of Effort and Cost</u>

§5.9(b)(7) – *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

The estimated cost of the Recreation Facility Inventory and Use & Needs Assessment Study for all three projects is about $150,000, including field studies, study report development, and drafting of a Recreation Management Plan. One field season should be sufficient to collect the required data and prepare the report.

Study Request #11 – Whitewater Boating Flow Assessment

Projects: Bellows Falls

Goals and Objectives

§5.9(b)(1) – *Describe the goals and objectives of each study proposal and the information to be obtained.*

The goal of this study is to assess the effects of a range of bypassed reach flows on whitewater recreational opportunities. The objectives of the study are to:

1. Determine what whitewater boat-types (e.g., rafts, canoes, and kayaks) would be appropriate to whitewater flows potentially provided in the bypassed reach.

2. Determine the range of flows (minimum through optimal) needed to support various whitewater boating opportunities (by watercraft type) in the project bypassed reach of the Connecticut River.

3. Determine whether current or future demand exists for whitewater boating in the bypassed reach.

4. Determine the number of days per month the minimum and optimum flows for whitewater boating are available under the project's current and any proposed mode of operation.

5. Determine any competing recreational uses (e.g., climbing or fishing) or other resource needs (e.g., aquatic habitat) that would be adversely affected by scheduled releases.

6. Identify any significant or unique hazards.

§5.9(b)(2) – *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.*

Not applicable.

§5.9(b)(3) – *If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.*

The Federal Energy Regulatory Commission must decide whether to issue a license to TransCanada for the Bellows Falls Hydroelectric Project. Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. In making its license decision, the Commission must equally consider the environmental, recreational, fish and wildlife, and other non-developmental values of the project, as well as power and developmental values. Any license issued shall be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses.

Comments provided during scoping indicate an interest in studying flows for boating opportunities on the 1-mile-long segment of the Connecticut River from Bellows Falls dam to the powerhouse. There is currently no requirement for flow releases into the bypassed reach. Comments received stated that releasing an appropriate amount of water into the bypassed reach could potentially provide whitewater park boating opportunities for public use, especially if combined with design and construction of whitewater park obstacles in this stretch of the river.

Background and Existing Information

§5.9(b)(4) – *Describe existing information concerning the subject of the study proposal, and the need for additional information.*

The PAD does not include information on the bypassed reach. After reviewing the comments provided during the January 29, 2013 scoping meetings, we have identified a gap between existing information and the information needed to analyze whether flows could be provided to enhance whitewater boating opportunities and whether there is demand for whitewater boating in the bypassed reach. We are unaware of any information on the characteristics or boatability of the Bellows Falls bypassed reach, or the range of boatable flows.

Project Nexus

§5.9(b)(5) – *Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.*

Project operation diverts flows from a 1-mile-long bypassed reach of the Connecticut River that could provide whitewater boating opportunities. Specifically, instream flows for the Connecticut River divert11,000 cfs from the bypass reach from Bellows Falls dam to the powerhouse. Thus, flows into the bypassed reach currently only happen if flows into Bellows Falls reservoir exceed approximately 11,000 cfs. An analysis of project operation relative to a range of boatable flows would help form the basis for informing potential license articles pertaining to whitewater boating opportunities.

Proposed Methodology

§5.8(b)(6) – *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.*

1. Use accepted practices for a controlled flow study as described in Whittaker et al. (2005) to visually assess whitewater boating flows in coordination with flows scheduled for the requested Instream Flow Aquatic Habitat Study, and any opportunities that may be provided by river flows in excess of 11,000 cfs at the Bellows Falls dam; and to the extent practicable based on these visual observations, determine the acceptable minimum and optimal instream flow needed for whitewater boating in the bypassed reach.

2. Prepare a study report that (1) describe the whitewater boating attributes of the range of flows examined, including level of difficulty, play spots, portage requirements, etc; (2) identifies the acceptable and optimal flows for the reach and the frequency of availability of the identified flows under current and any proposed project operation, and (3) incorporate relevant results from the Recreation Facility Inventory and Use & Needs Assessment including characterization of the suitability of the bypassed reach for whitewater boating (e.g., gradient, length, character of potential

flows), annual recreation use by activity type and season of the bypassed reach, and (4) assesses whether or not there is demand for whitewater boating in the bypassed reach.

3. The report should also describe any competing recreation uses or other resources (e.g., fishing, rock climbing) in the bypassed reach that could be adversely affected by providing scheduled releases of minimum and optimum flows for whitewater boating.

Level of Effort and Cost

§5.9(b)(7) – *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

This study could be conducted in coordination with the requested Instream Flow Aquatic Habitat Study; and as such. The estimated cost of the whitewater boating flow assessment is approximately $30,000.

Study Request #12 – Vernon Project Cultural Resources Study

Goals and Objectives

§5.9(b)(1) – *Describe the goals and objectives of each study proposal and the information to be obtained.*

The goal of this study is to determine the potential effects of the Vernon Project on archaeological and historic resources that are listed in or eligible for inclusion in the National Register of Historic Places (National Register).[18] The Cultural Resources Study, including identification of the area of potential effects (APE),[19] should be

[18] In structure and appearance, the Vernon Cultural Resource Study should resemble the two other cultural resource studies associated with the Wilder and Bellows Falls projects for this relicensing.

[19] The APE should, at a minimum, include the lands enclosed by the project boundary including both in-water and on-shore project lands and facilities, and lands or properties outside the project boundary where project operations or other project-related activities may directly or indirectly cause changes in the character or use of historic properties, if any historic properties exist.

developed in consultation with the Vermont and New Hampshire State Historic Preservation Officers (SHPO), and other interested parties.[20] The study area should encompass the APE.

The Cultural Resources Study should satisfy these specific study objectives:

a) Identify the Project's APE and seek the concurrence on the APE from the New Hampshire SHPO and the Vermont SHPO.

b) Identify, and complete an inventory of cultural resources that may be directly or indirectly affected by the project.

c) Evaluate the National Register eligibility of all cultural resources within the APE.

d) Identify any existing project-related effects (both direct and indirect) on historic properties, and determine how project operations or other project-related activities may affect or potentially affect them.

e) Prepare a study report or reports that include: (1) a background section on previous work in and around the APE; (2) a culture history of the research area; (3) definition and map of the APE; (4) methods used for the archival research and field pedestrian survey and how the APE was systematically inventoried; (5) the results of the survey and detailed descriptions of the cultural resources found (including a table depicting type of cultural resources, age, property ownership location, associated artifacts, existing and potential effects, and National Register eligibility status) ; (6) results of National Register evaluations for cultural resources located within the APE; and (7) site- specific descriptions of existing and potential project-related effects on cultural resources considered to be eligible for inclusion in the National Register.

f) Consult with the Vermont and New Hampshire SHPOs and other interested parties to resolve adverse effects on historic properties within the APE. If historic properties are or may be adversely affected by operation of the project or from project-related activities, you should revise the existing

[20] Although there are no federally recognized Tribes in New Hampshire or Vermont, there are Native American organizations that may attach religious and cultural significance to historic properties in the APE.

Historic Properties Management Plan (HPMP)[21] to address identified project effects.

g) File a draft revised HPMP along with your preliminary licensing proposal, and a final revised HPMP with your final license application.[22] Among other things, the revised HPMP should provide site-specific measures to resolve any potential project-related adverse effect to historic properties located within the project's APE.

§5.9(b)(2) – *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resources to be studied.*

Not applicable.

§5.9(b)(3) – *If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.*

The Federal Energy Regulatory Commission must decide whether to issue a license to TransCanada for the Vernon Project. Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. In making its license decision, the Commission must equally consider the environmental, recreational, fish and wildlife, and other non-developmental values of the project, as well as power and developmental values. Any license issued shall be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses.

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[21] A HPMP was prepared for the Vernon Project in accordance with the requirements of a 2006 Memorandum of Agreement (MOA) to address adverse effects associated with a license amendment as well as future operation of the hydro project in general. The HPMP (dated October 2008) was approved by the Commission in January 2010.

[22] Note that once the Commission finds the HPMP to be final, we would attach it to a programmatic agreement and after noticing the Advisory Council on Historic Preservation, we would execute the programmatic agreement with the Vermont and New Hampshire SHPOs, if the Advisory Council on Historic Preservation declines to participate. Execution of the programmatic agreement would evidence that the Commission has resolved any potential adverse effects to historic properties involved with the proposed project.

Historic properties [23] are of concern because of their importance in prehistory and history, representing major patterns of our shared local, state, and national experience. Ensuring that measures pertaining to these resources are considered in a reasoned way is relevant to the Commission's public interest determination. Additionally, this information is needed to ensure compliance with section 106 of the National Historic Preservation Act and its implementing regulations at 36 C.F.R. Part 800.

Background and Existing Information

§5.9(b)(4) – *Describe existing information concerning the subject of the study proposal and the need for additional information.*

In Section 3.12 of the PAD, you state that you conducted a Phase IA Archaeological Reconnaissance Survey to identify known archaeological sites within the project's APE and to identify areas of archaeological sensitivity where documented and previously recorded archaeological sites are likely to exist. You also state that you've completed a study to identify historic standing structures within the Deerfield and Connecticut River hydroelectric systems to establish a baseline archival record and that documentation was completed to Historic American Engineering Record (HAER) standards. A HPMP was prepared for the Vernon Project in accordance with the requirements of a 2006 memorandum of agreement to address adverse effects associated with a license amendment as well as future operation of the hydro project in general. In Section 4.10 of the PAD you state that the SHPOs approved a full assessment of specific project effects resulting from operation, maintenance and recreation use on cultural resources within the project's APE, including historic hydroelectric system features, consistent with the provisions of the executed MOA. As a result, TransCanada does not propose to conduct any additional cultural resources studies in association with the relicensing of the project.

Although we note the referenced HPMP provides a general definition and associated map of the APE, it does not have the detail we would need for our analysis involving this relicensing. Although you state in your HPMP that you conducted a Phase IA reconnaissance survey within the APE to identify previously reported archaeological sites and archaeological sensitivity areas, we must take into account the effects of issuing a new license for the Vernon Project on all historic properties listed in or eligible for inclusion in the National Register, not just those resources identified through previous

[23] Historic properties are prehistoric or historic districts, sites, buildings, structures or objects listed in or eligible for inclusion in the National Register.

studies. Therefore, in order to assess the effects of project operations and related activities on historic properties, we require an inventory of cultural resources within the project's APE and an evaluation of all inventoried resources to determine their eligibility for inclusion in the National Register.

Project Nexus

§5.9(b)(5) – *Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study would inform the development of license requirements.*

Continued operation and maintenance of the Vernon Project has the potential to affect previously identified or unknown historic properties within the APE. Such effects would include modification and repair of existing hydropower facilities, shoreline erosion to archaeological sites due to changes of elevation of the flood pool due to power generation, recreational causes on archeological sites including unauthorized collecting of artifacts and vandalism.

The study would identify and evaluate all archaeological and historic resources within the project's APE. If there would be an adverse effect on historic properties, an HPMP, developed in consultation with the Commission, the SHPOs, and other interested parties, may be required in a new license to avoid, lessen, or mitigate for adverse effects.

Proposed Methodology

§5.9(b)(6) – *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field seasons(s) and the duration) is consistent with generally accepted practice in the professional design community or, as appropriate, considers any known tribal values or knowledge.*

The generally accepted practice is to conduct a literature review and field reconnaissance to identify previously reported archaeological sites, historic resources, and areas of cultural resource sensitivity in the APE. The APE definition needs to include all lands enclosed by the project boundary including both in-water and on-shore project lands and facilities, and lands or properties outside the project boundary where project operations or other project-related activities may directly or indirectly cause changes in the character or use of historic properties, if any historic properties exist.

This background and literature review is generally followed by intensive investigation (usually accomplished by a systematic pedestrian survey within the APE), an evaluation of the National Register-eligibility of inventoried resources, an assessment of project effects on properties listed in or determined to be eligible for inclusion in the National register, and consultation with the SHPO, interested Indian tribes, and other interested parties (including the public or any other group interested in cultural resources that may be affected by the project) to resolve adverse effects on historic properties.

As noted in the PAD, a Phase IA literature review and archaeological sensitivity has already been completed. In accordance with any applicable the guidelines and standards promulgated by the Vermont and New Hampshire SHPOs, the Vernon Project Cultural Resources Study should use generally accepted practices in the scientific community to:

a) Document that the APE conforms to the definition noted above. Develop include a record of consultation with the Vermont and New Hampshire SHPOs and other interested parties regarding the APE or a proposal to complete such consultation as a component of the study.[24] Create a detailed map showing all aspects of the APE, including designations of land ownership.

b) Conduct an inventory of all archaeological and historic resources that may lie within the APE, including project facilities, non-project architectural resources, and properties of traditional religious or cultural significance. Your inventory should include intensive archaeological testing in addition to any other methods (if needed) by which other cultural resources that may be directly or indirectly affected by the project will be inventoried.[25]

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[24] Once you have defined your APE, send your APE definition and APE map to the Vermont and New Hampshire SHPOs and seek their concurrence. The APE definition and map should be included in your study proposal, along with a record of consultation with the two SHPOs regarding the APE.

[25] Your study proposal should clearly define the methods and applicable standards for conducting Phase IB or other intensive testing within the APE and for completing an inventory of historic buildings, structures, objects, and districts (including non-project architectural resources).

c) Evaluate the National Register eligibility of all cultural resources within the APE[26] through examination, testing and/or excavation of cultural resources.[27]

d) Identify, in consultation with the SHPOs and other interested parties, any existing project-related effects (both direct and indirect) on historic properties recorded during the field inventory, and determine how project operations may affect or potentially affect them.

e) Prepare a study report or report(s) that include: (1) a background section on previous work in and around the APE; (2) a culture history of the research area; (3) definition and map of the APE; (4) methods used for the archival research and field pedestrian survey and how the APE was systematically inventoried; (5) the results of the survey and detailed descriptions of the cultural resources found (including a table depicting type of cultural resources, age, property location and ownership, associated artifacts, existing and potential effects, and National Register eligibility status); (6) results of National Register evaluations for all cultural resources located within the APE; and (7) site or resource specific descriptions of existing and potential project-related effects on cultural resources considered to be eligible for inclusion in the National Register. Also integrate all existing cultural resources information you have already compiled and completed, as expressed in section 3.12, and in your 2008 HPMP and associated documentation and attachments.

f) Provide a record of consultation documenting that you have consulted with the Vermont and New Hampshire SHPOs and other interested parties regarding the applicability of the existing HPMP to resolve any potential adverse effects to historic properties within the project's APE. Include in this record of consultation any proposals to modify or amend the existing HPMP approved by the Commission in January 2010. Your record of consultation should also describe how you have addressed any comments

[26] If all National Register eligibility determinations cannot be done in either the first or second season of field investigations, a program to follow-up on completing all National Register eligibility determinations of properties located within the APE could be developed and included in the HPMP.

[27] Your study proposal should describe the methods for evaluating the National Register eligibility of archaeological and historic resources within the APE.

> on or requests to modify the HPMP. You should file a draft revised HPMP along with your preliminary licensing proposal, and a final revised HPMP with your final license application.[28] Among other things, the revised HPMP should provide site-specific measures to resolve any potential project-related adverse effect to historic properties located within the project's APE.

Level of Effort and Cost

§5.9(b)(7) – *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

The cost of the study and associated report(s) is estimated to be between $140,000 and $150,000, depending on the scope and intensity of the investigations and the number of resources identified. The survey and report(s) would likely take one study season to complete.

[28] You should use the Guidelines for the Development of Historic Properties Management Plans for FERC Hydroelectric Projects, developed by the Advisory Council on Historic Preservation and the Commission in May 2002.

F. WILLIAM LIPFERT, JR., AND JENNIFER LIPFERT
1349 NH Route 12A
Cornish, NH 03745

February 25, 2013

Kimberly D. Bose, JD, Secretary
Federal Energy Regulatory Commission
888 First Street NE
Washington, DC 20426

Re: Wilder Project (FERC Project No. 1892-026) Scoping Study Request

Via certified mail

Dear Secretary Bose:

The undersigned are owners of land in Cornish and Claremont, New Hampshire, with approximately one mile of frontage on the Connecticut River downstream from the Wilder Project. Pursuant to the December 2012 "Scoping Document 1," this letter constitutes a formal request for a study related to the benefits of limiting the rate of change of Wilder dam discharges in reducing dam-related erosion of the riverbanks.

A July 2012 report by the Upper Valley Land Trust (a 501(c)3 organization that holds a conservation easement on a portion of our land) notes that a 1968 survey entitled "Property of Harrison E. Miles prepared by Breckenridge Land Surveys" records the distance from the railroad tracks to the river's edge of our property as 622 feet. The Land Trust measured this distance in the summer of 2012 and found the distance to be 490 feet – an alarming 132-foot longitudinal loss of land. Multiplying this distance by the 30+ foot bank height and hundreds of feet of frontage, this equates to thousands of cubic yards of material that have been lost. This significant erosion jeopardizes agricultural soils of statewide significance and threatens the existence of the endangered dwarf wedge mussel. The attached photo shows a portion of our property with significant active erosion along the river front.

As you know, the dwarf wedge mussel (*Alasmidonta heterodon*) is classified as an endangered species by the federal government. According to the U.S. Fish and Wildlife Service, this mussel once inhabited much of the mainstem of the Connecticut River and many of its tributaries but now is found at only four sites in the watershed – including the frontage along our property. The U.S. Fish and Wildlife service notes that "siltation…degrade[s] mussel habitat."

We attribute the significant erosion problem on our property to rapidly fluctuating water levels on the river caused by the operation of the Wilder Dam. Our children have seen shoes, towels and swim gear swept downstream because the change in water level is so rapid on summer afternoons that they cannot react in time. Wilder Dam operation has caused kayaks to capsize and has resulted in at least one fatality (a local fisherman whose hip waders became flooded due to rapidly rising water level, resulting in drowning).

It is our understanding that flow from the dam can vary from a minimum of 700 cubic feet per second (cfs) to the facility's full hydraulic capacity of 10,700 cfs. This change in flow – a 15-fold increase in water volume – can occur almost instantaneously. Our concern stems not from any particular flow rate but, rather, from the lack of any FERC-imposed or voluntary measures to provide reasonable limitations in *rate of change* in flow. We suggest that a limitation in *rate of change* in flow of 5000 cfs per hour (that is, requiring the operator to transition from minimum flow to full hydraulic capacity over two hours when practicable to do so) is a reasonable operating requirement that will enhance safety, reduce erosion and minimize degradation of habitat for endangered species.

In accordance with the December 2012 "Scoping Document 1," we request a comprehensive hydrology and soils study of the benefits of imposing a rate of change limitation in flow of 5000 cfs per hour (or similar value) as a requirement for Wilder Dam relicensing in 2018. We request that the study utilize detailed and site-specific computer simulation models to compare predicted soil erosion with and without such rate of change requirements. We would be pleased to support the effort by providing access to our property for computer simulation model development and calibration. We request that such a study be performed by an independent laboratory (such as the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL)) or research university. We specifically request that such a study not be performed by a consultant engaged by the project applicant due to conflict of interest concerns.

You can reach us at the above address or at 1-603-448-8738 (days) or 1-603-675-9110 (evenings) should you have any questions. We look forward to your response.

Very truly yours,

F. William Lipfert, Jr.

Jennifer Lipfert

cc: Kenneth Hogan, FERC

Att: 7 paper copies of this letter and supporting documentation

Document Content(s)

TO: Federal Energy Regulatory Commission
Office of Energy Projects

FROM: John T. B. Mudge
25 Lamphire Hill Lane
Lyme NH 03768
Tel: 603-795-4350 Fax: 603-795-4355
Email: JMudgeNH@aol.com

RE: **Wilder Project, (FERC NO. 1892-026)**

Study Request:

Erosion of Farmland Caused by the Wilder Dam

DATE: February 25, 2013

CONTENTS:

To the reader:

For further information or to visit the Mudge fields, please contact me at the above address and phone.

Very truly yours,

John T. B. Mudge

I. Background

In 1962 my parents bought a 190± acre farm on the Connecticut River in Lyme, New Hampshire. In 1966 they bought an adjoining 17± acre field with the result that they then owned ¾ mile of frontage on the Connecticut River, about 58 acres of prime agricultural land, and a farmhouse and barns on a terrace over-looking the three fields, often referred to within the family as "the lower fields"—fields A, B & C, from south to north, on a survey map prepared in 1989.

The fertile lands at the bottom of the Connecticut River valley have long been known to be very valuable farmland. Different books and articles have described these lands as "farm soils that are among the best in the country, some say the world," "New England's breadbasket," and "a garden of delight."

Recognizing the importance of these fields from an agricultural point of view, a conservation easement with the New Hampshire Department of Agriculture was put on a portion of the land in 1989, and an additional easement was put on the rest of the land in 2006 with the Upper Valley Land Trust. This land will never be developed, and by following the best agricultural practices, it will forever produce food products.

There is now, and has been for a number of years, another threat to these fields. The fields are disappearing because of erosion. There are two ways to see this erosion: 1) two survey maps and 2) photographs. This will be addressed in detail beginning at page 7.

On January 28, 2013, at a FERC Scoping Meeting held in West Lebanon, New Hampshire, a spokesman for TransCanada, the company that owns the Wilder Dam, stated that the company did not "propose" a study on geology and soil resources as a part of the license renewal procedures for that dam. The purpose of this material is to request that such a study be made.

II. *Study Request*

§5.9(b)(1) — *Describe the goals and objectives of each study proposal and the information to be obtained.*

The goal of this study is to evaluate the effects of the operation of the Wilder Dam on the erosion of farmland along the Connecticut River.

Specifically, the objectives of the study should include:

- Determine how the raising and lowering of the water level in the Connecticut River is a factor in the erosion of the riverbanks in both New Hampshire and Vermont and the resulting loss of agricultural farmland— valuable Hadley Silt Loam.
- Determine if and how the form of erosion known as "piping" has affected the riverbank.
- Document how the operation of the dam and the daily fluctuations in the water level have affected town roads that are beside the river.
- Document how the flow of the river, the operation of the dam, and the raising and lowering of water levels has eroded land and caused the widening of the river with the result that ever more land is then eroded.

**

§5.9(b)(2) — *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.*

Not known to be applicable.

**

§5.9(b)(3) — *If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.*

When reviewing a proposed action, in this case the renewal of the license for the Wilder Dam, the Commission must consider the environmental, recreational, fish and wildlife, and other non-developmental values of the project, as well as power and developmental values.

The requested study should address both land erosion issues on this section of the Connecticut River and also the increased sedimentation in the river which affects fish and wildlife that is a result of the erosion. The Commission has an obligation to address these issues.

The U. S. Department of Agriculture has provided grants to landowners, including my family, for erosion control projects on the riverbank. Grants were made to my family in 1992, 1996, and 2012. The erosion represents a *cost* to the federal government. It is in the public interest for the Commission to consider these costs to the Federal government as it grants a license to the dam.

**

§5.9(b)(4) — *Describe existing information concerning the subject of the study proposal, and the need for additional information.*

In September 1992, D. J. Hagerty of the Civil Engineering Department at the University of Louisville, prepared a report for the U. S. Army Corps of Engineers, "Identification of Piping and Sapping Erosion of Streambanks." Piping, the process of erosion that he describes, is what is occurring on the Connecticut River. Portions of the Hagerty study are quoted below:

> "To understand bend erosion, it is necessary to investigate mechanics of erosion due to various causes including piping and sapping…
>
> "The major portion of this text is a description of evidence, direct and indirect, which indicates that piping and/or sapping has occurred on a given bank site. Direct evidence is limited to the condition of water actually flowing out of a bank and removing soil particles, in the sight of an observer or under detection by a monitoring device such as a motion picture camera. Indirect evidence includes primary evidence such as cavities in the bank face and deposits of removed particles in deltas or fans below a piping/sapping zone.
>
> "If water flows out of a streambank under a sufficiently high hydraulic gradient, the exfiltrating water can remove particles of soil from the bank face. This movement of soil particles by seeping water in soil voids is called internal erosion. Should the flow be concentrated by variations in hydraulic conductivity or by restriction of water supply (as from a leak from an underground pipe), the exfiltrating water can create cavities in the bank face. Because such cavities commonly have roughly cylindrical shape and are oriented virtually perpendicularly to the bank face, they have been called "pipes" and the internal erosion process by which they form has been called "piping." ……If exfiltration occurs over a broad area so that multiple "pipes" form or larger lenticular cavities appear, this process may be called "sapping."
>
> "…This process can be significant because the mechanism tends to intensify; removal of soil at the exfiltration face shortens the seepage path and increases the hydraulic gradient which causes the outflow. If the source of water is constant or is replenished periodically, the internal erosion tends to intensify. …local instability may be created in the soils above the cavity.

> Failure and erosion of streambanks occur by instability of bank soils undercut by piping cavities…
>
> "Among the circumstances that must prevail if piping or sapping is to happen, the one condition which is absolutely necessary is concentrated flow of intensity sufficient to remove an in situ particle of soil, entrain it, and carry it away from its point of origin…   …Finally for internal erosion to produce cavities, there must be a free face or an external plane from which the water can move the soil particles… There must be an exit point by which seeping water can leave the bank and carry along dislodged particles, or piping cavities will not form…
>
> "The most obvious source of water to supply the piping/sapping process on a stream-bank is the stream itself. When the stream rises against the face of the bank, water enters the bank soils…"

Published in 1980, Katharine Blaisdell's book *Over the River and Through The Years* includes, with her discussion of the unearthing of Native American artifacts through erosion, the following sentence: "The erosion of riverbanks has become a serious problem for farmers with meadows which border the Connecticut River — and are disappearing into it."

As a landowner, I have never seen a study of the erosion on this portion of the Connecticut River. Much more scientific information is needed about the relationship between the operation of the Wilder Dam and the erosion of the Hadley Silt Loam that forms the riverbank before another license is given to the operators of the dam.

**

§5.9(b)(5) — *Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.*

As shown in the accompanying photographs and diagrams, the erosion has had an adverse affect on the Hadley Silt Loam that is the soil at the bottom of the valley and forms the riverbank on this section of the Connecticut River. These are prime agricultural soils. Continued erosion of the land will result in the loss of more and more agricultural land and increased sedimentation in the river. Just through their personal observations, landowners are able to recognize the relationship between the rapid fluctuations in the level of the water in the river and the flow of the river and the resulting erosion.

**

§5.9(b)(6) — *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.*

Trained experts in the causes and affects of erosion, in addition to civil engineers to measure the extent of the erosion and biologists to measure the impact of the sedimentation in the river, should be able to establish the relationship between the changing levels in the river and the flow of the river and the erosion. Field studies will be necessary to complete the requested work.

This erosion will be clearly evident to anyone just taking a boat tour of the river. The erosion is also visible when driving along some of the roads. The erosion is shown in the accompanying photographs.

It will probably be necessary to coordinate this study with the operators of the dam so that the person(s) preparing the study are able to not only study the riverbank when the river is high, but also when the river is very low. The dam operators may have to lower the level of the water for an extended period of time to permit this study.

**

§5.9(b)(7) — *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

The cost of a detailed study in unknown. It will take some period of time and a number of different professional people to complete the study. It will take a serious effort to prepare the study plan, extensive fieldwork, and additional time to analyze the data and prepare reports. It should be remembered that the "pond" behind the Wilder Dam is about 45 miles in length, and that requires studies of 90 miles of riverbank in two states.

The cost in the loss of land and sediment in the river is very great. As stated earlier, the cost to the U. S. Department of Agriculture in assisting landowners to control the erosion is already very great.

***

III. The Mudge Fields.

This discussion and these photographs describe and illustrate the existing erosion.

Two surveys of the lower fields

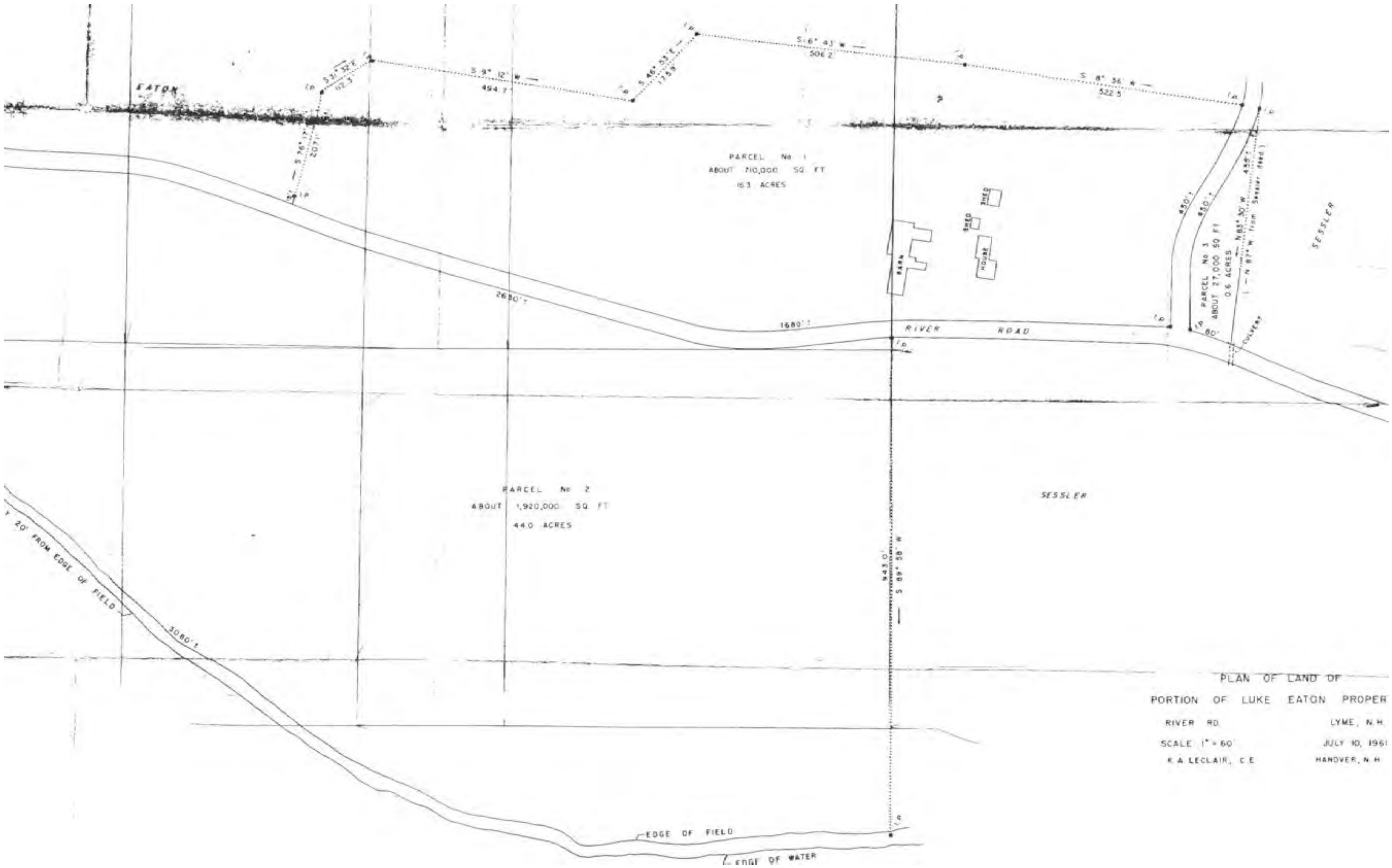
Q: *If a picture is worth a thousand words, what is a survey map worth*?

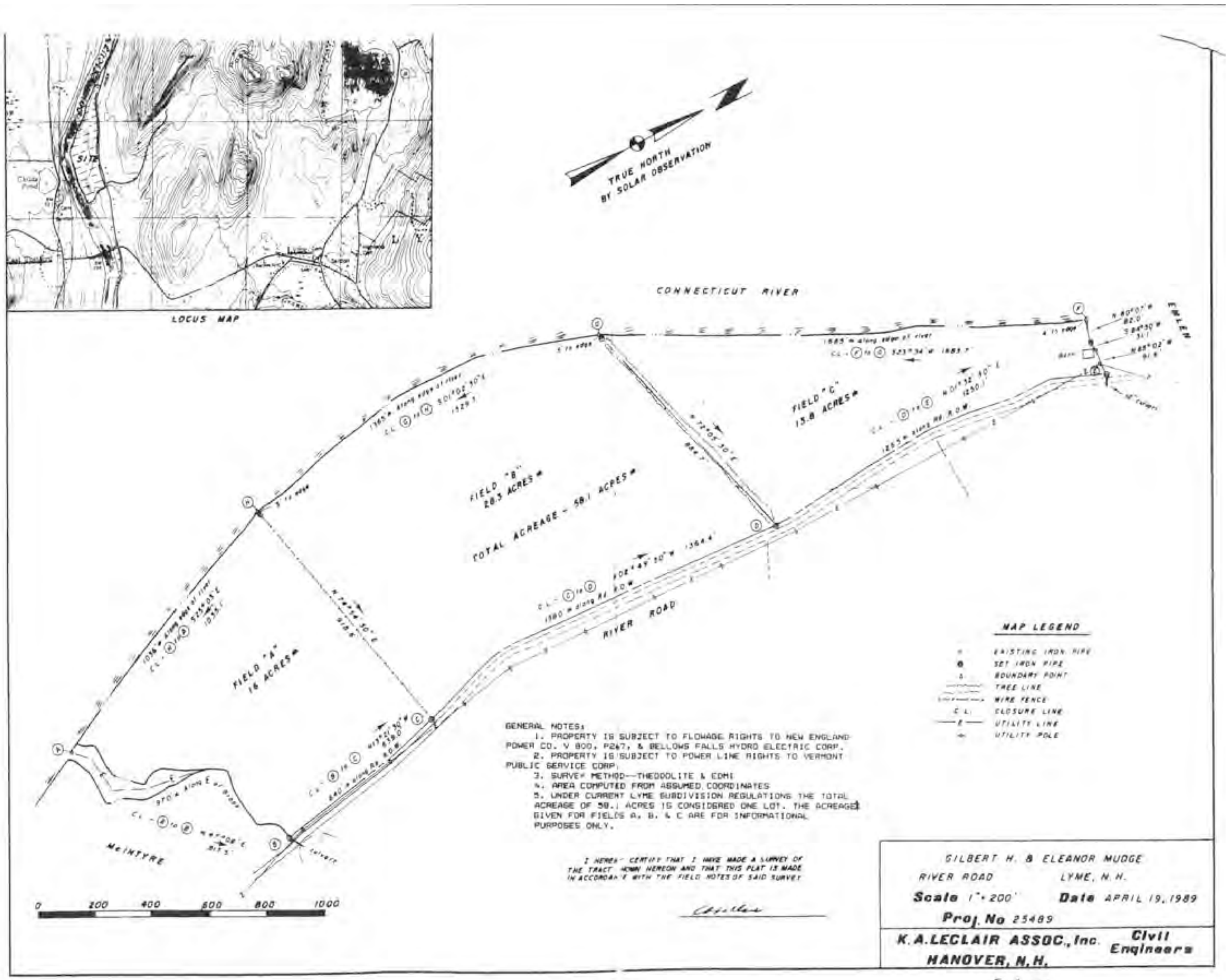
A: *Acres*.

When the farm was purchased in 1962, the attorney provided a survey prepared by K. A. LeClair, C. E. of Hanover titled, "Portion of Luke Eaton Property" dated July 10, 1961. The 1961 survey is of what are now called Fields B & C.

In 1989, when the conservation easement was placed on Fields A & B, LeClair prepared a survey of all three fields, A, B & C. I have been told that we are the only landowner in the area with two surveys that so clearly document the erosion.

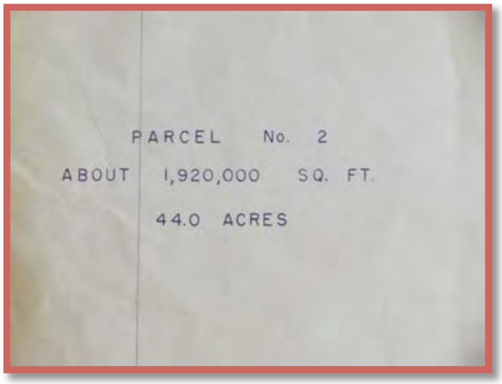
The 1961 and 1989 surveys are on the next two pages. The 1961 survey was drawn to a scale of 1" = 60 feet, and is printed on a piece of paper 67" x 33". It may not be very easy to read here. The 1989 survey has also been reduced from its original size.

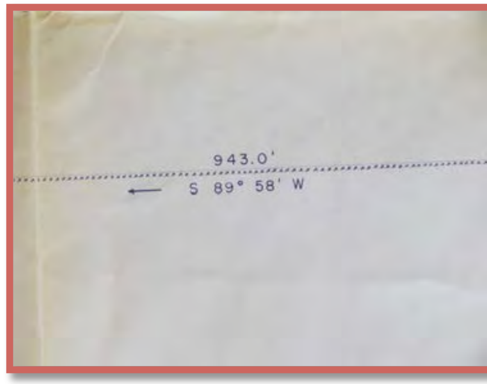

PLAN OF LAND OF
PORTION OF LUKE EATON PROPER
RIVER RD.
LYME, N.H.
SCALE 1" = 60'
JULY 10, 1961
K.A. LECLAIR, C.E.
HANOVER, N.H.
PARCEL No. 1
ABOUT 710,000 SQ. FT.
16.3 ACRES
PARCEL No. 2
ABOUT 1,920,000 SQ. FT.
44.0 ACRES
PARCEL No. 3
ABOUT 27,000 SQ. FT.
0.6 ACRES
EATON
SESSLER
SESSLER
SESSLER
RIVER ROAD
BARN
SHED
SHED
HOUSE
CULVERT
S 6° 43' W
506.2'
S 8° 36' W
522.5'
S 9° 12' W
494.7'
S 46° 53' E
S 89° 38' W
943.0'
1680'±
2680'±
3080'±
450'±
450'±
455'±
N 83° 30' W
N 87° W (from Sessler deed)
80'
EDGE OF FIELD
EDGE OF WATER
20' FROM EDGE OF FIELD



TRUE NORTH
BY SOLAR OBSERVATION
LOCUS MAP
CONNECTICUT RIVER
EMLEN
FIELD "C"
13.8 ACRES ±
FIELD "B"
20.3 ACRES ±
TOTAL ACREAGE - 58.1 ACRES ±
FIELD "A"
16 ACRES ±
RIVER ROAD
McINTYRE
MAP LEGEND
EXISTING IRON PIPE
SET IRON PIPE
BOUNDARY POINT
TREE LINE
WIRE FENCE
CLOSURE LINE
UTILITY LINE
UTILITY POLE
GENERAL NOTES:
1. PROPERTY IS SUBJECT TO FLOWAGE RIGHTS TO NEW ENGLAND POWER CO. V 800, P267, & BELLOWS FALLS HYDRO ELECTRIC CORP.
2. PROPERTY IS SUBJECT TO POWER LINE RIGHTS TO VERMONT PUBLIC SERVICE CORP.
3. SURVEY METHOD—THEODOLITE & EDMI
4. AREA COMPUTED FROM ASSUMED COORDINATES
5. UNDER CURRENT LYME SUBDIVISION REGULATIONS THE TOTAL ACREAGE OF 58.1 ACRES IS CONSIDERED ONE LOT. THE ACREAGE GIVEN FOR FIELDS A, B, & C ARE FOR INFORMATIONAL PURPOSES ONLY.
I HEREBY CERTIFY THAT I HAVE MADE A SURVEY OF THE TRACT SHOWN HEREON AND THAT THIS PLAT IS MADE IN ACCORDANCE WITH THE FIELD NOTES OF SAID SURVEY
0 200 400 600 800 1000
GILBERT H. & ELEANOR MUDGE
RIVER ROAD LYME, N.H.
Scale 1" = 200' Date APRIL 19, 1989
Proj. No 25489
K.A.LECLAIR ASSOC., Inc. Civil Engineers
HANOVER, N.H.

Two details from the 1961 survey map are shown below. In 1961, "Parcel 2" referred to what in 1989 are Fields B & C:





These details show the acreage of fields B & C and the bearing and distance of the line between fields A & B. This bearing is shown on the 1989 survey as N 74° 54' 30" E, the difference being that magnetic north was used in 1961 and a solar observation was made in 1989— therefore, the magnetic declination of about 16°.

From the two surveys:

	1961 LeClair Survey	1989 LeClair Survey
Length of boundary between fields A & B	943.0 feet	916.6 feet
Acreage of Fields B & C	44.0	42.1
River frontage	Fields B & C: 3,080± feet	Fields A, B & C: 4,086± feet– Approximately .77 miles.

As the result of erosion, fields B & C lost 1.90 acres between 1961 and 1989.

As the result of erosion, the boundary line between Fields A & B was 26.4 feet shorter in 1989 than in 1961. A yellow surveyor's pin that was at the western end of this line in 1962, by the river, is now gone.

If the entire riverbank for fields B & C, 3,080 feet, had eroded 26.4 feet in that time period, that would amount to 1.87 acres.

Yes, survey maps are worth *acres*.

There have been over twenty years of additional erosion since 1989. Additional land has been lost. Additional silt has been added to the river.

The two surveys clearly document the extent of the erosion that has taken place and is continuing to occur on these and other lands along the river.

IV. The Erosion

How is the erosion occurring, both on these fields and throughout this portion of the Connecticut River Valley?

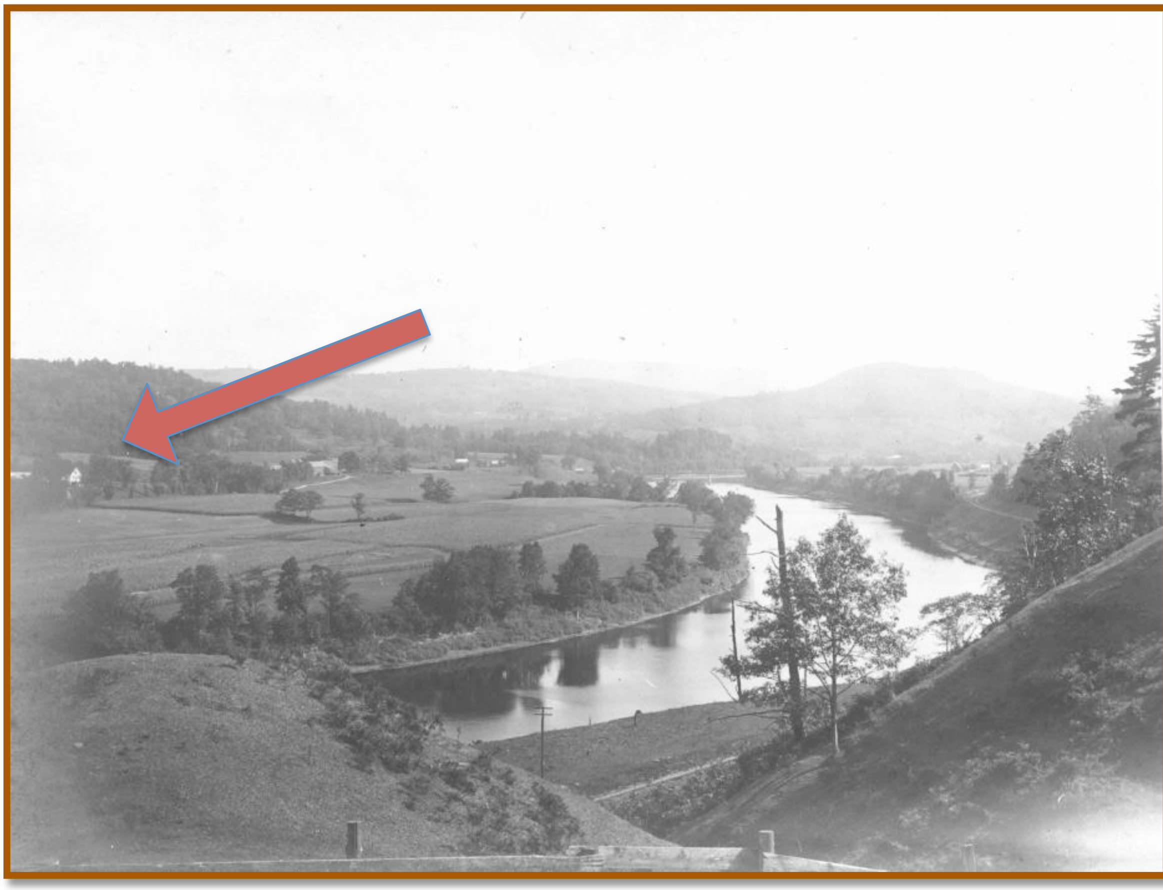
Remember, this is not a free flowing river. The Connecticut River, or sometimes called Wilder Lake, is controlled by a dam, and the water may go up and down by as much as five feet in a day. As the dam opens and closes, the flow of the river speeds up, stops, and goes backwards. The result of the operations of the dam is that the dynamics of the river are not the natural flow of a river, and this is not a lake as is normally thought of lakes– bodies of water that do not go up and down in such a dramatic and frequent way.

Some say that the erosion is caused by ice flows. No. In over fifty years, I have never seen an ice flow or ice jam on this portion of the river. Remember, it is all controlled by a dam. If you want to see an ice flow, visit White River Junction in the spring as the White River is thawing.

What is the problem? Drawings and photographs will show how this erosion works.

"Piping," as a consequence of the operation of the Wilder Dam, may be the cause of the erosion

Imagine a time before the dam was built and the water was at a hypothetical 380' above sea level and there was little daily fluctuation in the river.



This is the earliest known photograph of the Mudge fields, a pre-1896 photograph, looking southeast from the Vermont side of the river, from up near Route 5, between East Thetford and North Thetford. The date can be estimated because the covered bridge in the background was destroyed in 1896.

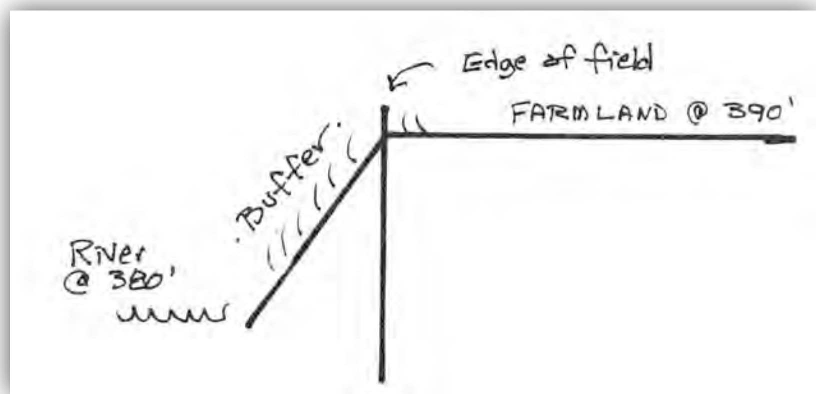
The Mudge house, see arrow, is on the far left side in the center of the picture

The fields *are* the photograph.

This photo clearly shows the vegetation on the riverbank. The shrubs protected the bank at high water times, and the trees provided additional buffer. There was a well established riparian buffer.

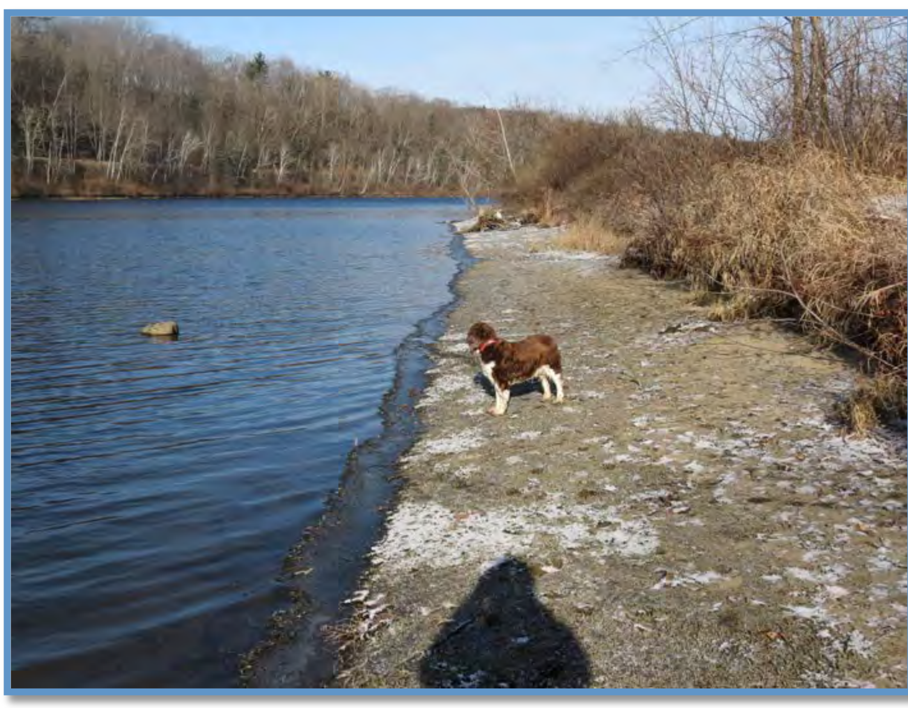
In 2013, all of these shrubs and trees are gone. There is no protection. Today there is no riparian buffer, and no such buffer can be created.

In the below sketch, imagine the river at a hypothetical 380’ before the dam, with bushes and trees along the bank forming a buffer, much as in the earlier picture. The buffer is also at the border of the farmland, at an elevation of 390’.



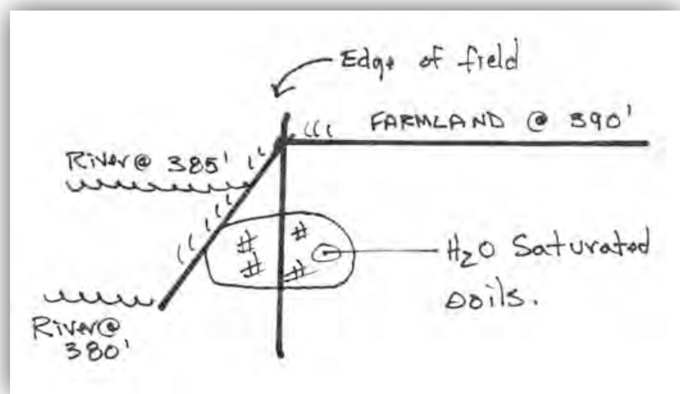
All is fine with this situation.

Now build the dam.



As shown in the above photograph, the stumps of the trees cut in the 1940s are still visible when the water is low. These trees were on the riverbank before the dam was built. The mud flats are a result of the erosion. Notice the distance between the stump, the location of the old bank, and the bank today.

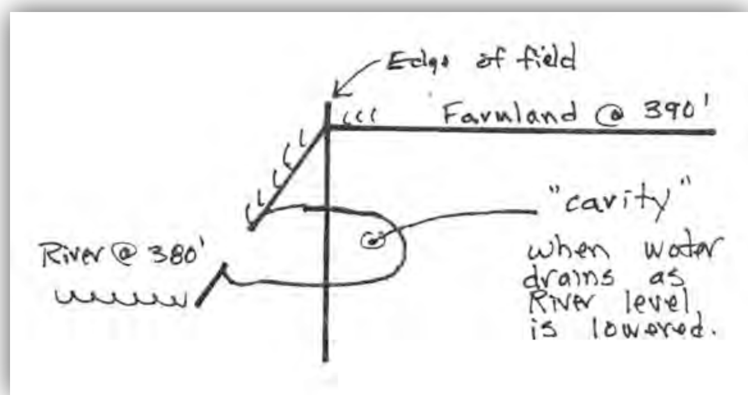
With the construction of the dam, the level of the water fluctuates, but the flowage rights are “not to exceed an assumed elevation of 385 feet.” The deeds granting flowage rights say nothing about the width of the river, just the elevation of the water.



In the above diagram, the water is at the 385’ level *and* water has saturated the bank and farmland. The water quickly saturates the Hadley Silt.

Then the water level goes down—

When the water is lowered, the saturated Hadley soils drain, and with the water goes some soil. This continues on a daily basis— a small amount of soil every day. Eventually, a cavity, a hole with perhaps a domed roof, is created below the surface of the ground, out of sight, as shown in the below sketch— piping.



A hole in the riverbank was visible when the river level was low on November 30, 2012, the date of the below photograph. The saturated soil has drained and the soil has been eroded when the river was lowered. This hole is four feet deep. Many such holes are visible when the river is low., These holes are invisible when the water level is high, but they are still there— filled with water.

"Indirect evidence [of piping] includes primary evidence such as cavities in the bank face and deposits of removed particles in deltas or fans below a piping/sapping zone."
— D. J. Hagerty, University of Louisville

Next there are what landowners refer to as *sinkholes* along the river!

For a property owner, the sinkholes are the *first visible* consequences of the erosion. They are seen as you walk in the fields along the edge of the river. You do not see the "cavities" beneath that have been caused by the washing away of the soil because those are only visible from the mud flats when the river is low. You see the sinkholes when the "cavities" cave in.

Late 1970s *January 2012*

Sinkholes in the fields on the edge of the Connecticut River in Lyme, N. H.

On the left, Mrs. Eleanor Mudge is standing in a sinkhole, five to six feet deep, that is a result of the erosion, while the family dog appears to be suspicious of the hole.

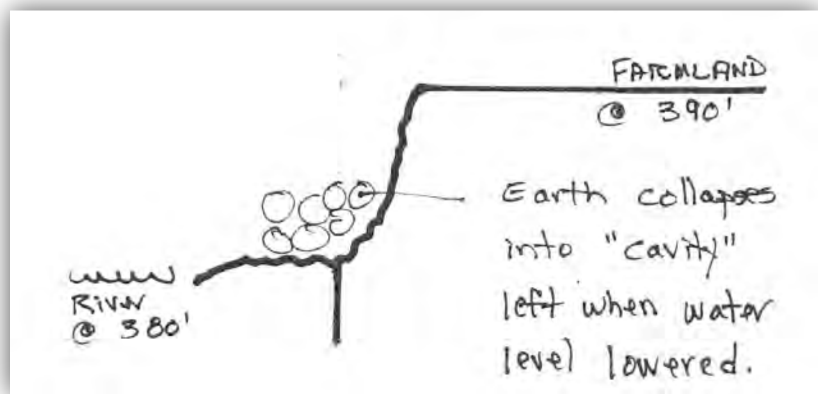
On the right, another family dog, (there have been three Springer Spaniels on the farm), seems suspicious of another sinkhole, also five to six feet deep.

Sinkholes are not good for prime agricultrual land. Some farm equipment has been damaged when a hole has collapsed beneath it. At least one horse has stumbled into one of these holes.

…local instability may be created in the soils above the cavity. Failure and erosion of streambanks occur by instability of bank soils <u>*undercut*</u> *by piping cavities…*

— D. J. Hagerty, University of Louisville

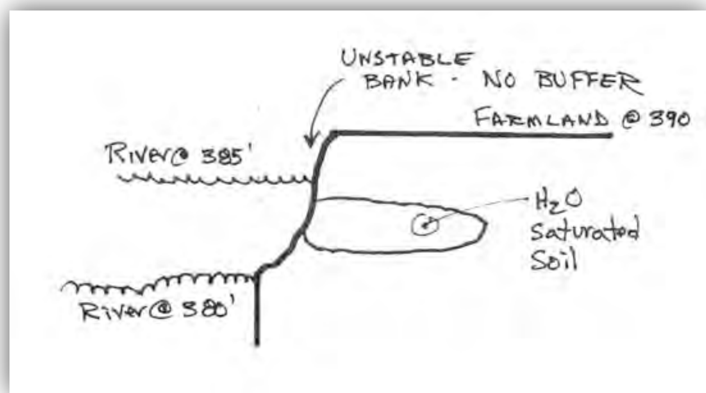
As shown in the below diagram, eventually the ground collapses, the domed cavity collapses, and sinkholes form. The edge of the field has been moved back and the riverbank is now unstable since there is no vegetation on it.



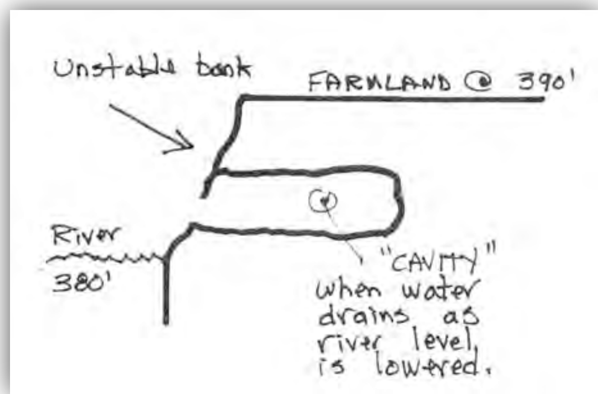
As shown above, today, November 30, 2012, the riverbank is unstable and there will be continued erosion. This is bank failure as the result of the undercutting of the bank, and there is much slump material that will continue to erode.

"Failure and erosion of streambanks occur by instability of bank soils undercut by piping cavities…" — D. J. Hagerty, University of Louisville

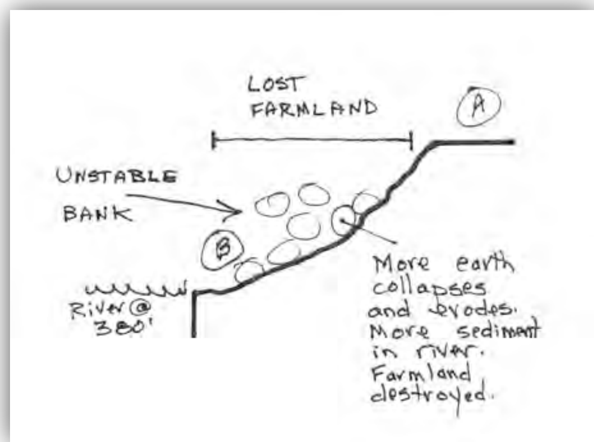
In the below sketch, the process repeats itself— on a daily basis the water level is raised and lowered and the natural flow of the river is manipulated. As the water is raised, the soil becomes saturated, and then, as the water level goes down, and the saturated soil is flushed out, another cavity is slowly, silently, and undeniably formed.



In the below diagram there is the cavity and the unstable bank.



Eventually the land collapses, there is a sinkhole, more erosion, more farmland is lost, and more sediment is in the river.



By now, people are saying that there should be a buffer at “A” in the farmland, but they are ignoring the fact that the erosion is happening at “B” and that the bank is being *undercut* by the rise and fall of the water levels. The simple truth is that no amount of planting at “A” will stop the erosion at “B”. The riparian buffer must be by the water at “B.” Vegetation is in the pre-1896 photograph, page 12. However, because of the dynamics of the river, the raising and lowering of the water, no vegetation will ever grow at “B” today and planting at “A” is of no use.

Just as the bank is being undercut, trees growing near it are being undercut.

These trees will eventually fall into the river and take with them tons of soil.

The erosion continues unabated. November 30, 2012—

Visible when the river was very low: The stump of a pre-Wilder Dam tree, the wider river area and the mudflats, the continued undercutting and erosion of the bank caused by the saturation of the soils along the riverbank and the subsequent collapsing and formation of sinkholes that will then continue to erode more and more land.

This cycle of erosion caused by the Wilder Dam constantly repeats itself as the level of the water rises and falls every day. This is not natural erosion that you would find in a lake. It is not the erosion that would be here if the riverbanks were bedrock rather than Hadley Silt Loam. There was a vegetation buffer before the dam was built, but the erosion prevents new vegetation from getting established. The erosion continues. Planting a buffer of shallow rooted bushes up in the fields will not prevent erosion down at the river, perhaps 6-8+ feet lower, where the higher land is being undercut by the raising and lowering of the river.

The flowage rights specified in the deeds are to an elevation of 385 feet, but the result of the saturation of the soil, the "piping", the unstable soils, the collapsing of the sinkholes and the ever continuing erosion means that much land above 385 feet has been undercut and eroded. The river has become wider. Valuable farmland has been lost.

To prevent more erosion, it may be necessary to modify the way that the Wilder Dam operates. How can the already created problems be corrected? It may take a massive mitigation effort to establish new vegetation along the river's edge.

In his book *Confluence— A River, The Environment, Politics, & The Fate of All Humanity,* a book about the Connecticut River, Nathaniel Tripp writes about the river's edge: "It is in the river's edge environment, as it is in the edges of other systems, that the variety of life is both the richest and the most sensitive to disturbance. It is in the edge, where the waters rise and fall, that eggs are most likely incubated, that larvae emerge, that seeds sprout, each species having evolved in synchrony with the river's rise and fall. When that flow is manipulated — when the magnitude, frequency, duration, and timing of flows are changed by the many uses of humankind such as dams for power generation or recreation, or water withdrawals for industrial uses, irrigation, or snow-making — there are ripple effects throughout the ecosystem that are only now beginning to be understood. Aside from the well–known cleansing and renewal of extremely high flows, there are also ecosystem benefits from extremely low flows, such as the elimination of invasive species. But few species can thrive in a river that experiences both high flows and low flows several times a day."

***

V. Photographs

The National Geographic, April 1943.

This photograph by *National Geographic* photographer B. Anthony Stewart (1904-1977) was taken near the cemetery north of East Thetford VT. Stewart joined the National Geographic in 1927 and remained with that publication until his retirement in 1969. He said of his work that it was "planned but not staged." At the time of his death, Stewart had contributed more photographs to the *National Geographic* than any other photographer.

"Beside the Venerable Connecticut, a New Generation Gathers Goldenrod — Here the river passes East Thetford, Vermont— one stretch of its 400-odd miles of rapids, oxbow turns, and tidewater. From wilderness to lovely village, to smoking city, it nourishes a cross section of New England. Indians canoed it; early settlers made it their road. Flood and hurricane have not dismayed it."* [*Joann Huggett Tomlinson]

Haying Field A.

Once upon a time— Butternut Trees, now gone, growing along the edge of Field A.

Three pictures of erosion on the Mudge fields, Lyme, N. H. November 30, 2012.

The River's Edge

Hole, 5 feet deep.

Looking across to the Vermont side of the river:

Rocks below the railroad tracks across from the Mudge fields. Rocks and vegetation are protecting the riverbank.

Trees about to fall into the river in East Thetford, VT, across from the Mudge fields.

Protected riverbank in VT.

Two NRCS – U. S. Department of Agriculture projects on the Mudge fields, 2012:

A.

B.

NRCS (Natural Resources Conservation Services) approved these projects and then NH–DES (New Hampshire Department of Environmental Services) required changes. In Photo A (upper) the rocks go to the water and there is woven geotextile beneath the rocks. In Photo B (lower) NH–DES would not allow the rocks or fiber to extend to the water though the erosion extended to the water. The erosion control work in Photo B will probably fail as the water penetrates underneath the rock that has been laid down and then the rocks will collapse. The erosion control work in Photo A will probably succeed, and there will be vegetation there in future years. Both sites had silt dams. The entire project is intended to prevent the massive silting of the river that is caused by the erosion when the water undercuts the bank. The silt being "controlled" by these silt dams is but a tiny fraction of the silt that is being eroded. I believe that landowners and the USDA understand the causes of the erosion. It is important that all parties come to understand what is happening on the banks of the Connecticut River and work together to control it.

The above project was probably done in 1996 and clearly shows the vegetation, grass and bushes, that comes back over time.

And lastly, a tree near the riverbank—

and—

its root system—

In a very short period of time this tree will fall into the Connecticut River and take with it tons of soil— prime agricultural soil that is "protected" by conservation easements. Bank erosion. Bank failure. Lost farmland. Sediment in the river.

This is as clear a picture as is possible of the undercutting that is occurring along the entire riverbank. The tree did not grow this way. This erosion has *no*t been caused by water running over the field. *The riverbank is being undercut by the operation of the Wilder Dam.*

Today this is the "edge "of the field, but years ago this tree was twenty feet from the edge of the field. I took this picture standing on the mud flats and can remember when there was another larger tree 15-20 feet further to the west, behind me, towards the river. It and many tons of irreplaceable soil are gone.

No amount of planting and attempting to create a riparian buffer at the top of the bank will control this erosion.

The lost land is irretrievable. Where will the edge of the field be in 25 years? Where will food be grown?

Farmland erosion caused by the Wilder Dam must be stopped.

United States Department of the Interior

NATIONAL PARK SERVICE
NORTHEAST REGION
15 State Street
Boston, Massachusetts 02109-3572

IN REPLY REFER TO:

February 28, 2013 Filed Electronically

Kimberly Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

Comments and Study Requests in Response to the Notice of Intent to File License Application, Filing of Pre-Application Document (PAD), Commencement of Pre-Filing Process and Scoping and Request for Comments on the PAD and Scoping Document: Vernon Hydroelectric Project (FERC 1904-073), Bellows Falls Hydroelectric Project (FERC 1855-045) and Wilder Hydroelectric Project (FERC 1892-026). TransCanada Hydro Northeast, Inc.

Dear Secretary Bose:

General Comments

The National Park Service files these comments in order to facilitate the relicensing process for both applicants and offers this agency's technical expertise on public recreational access, land conservation and preservation and our understanding of the values placed by the general public on river related resources. Together, the five projects currently up for relicensing directly influence almost 170 miles of New England's longest river and represent five of the nine Connecticut River mainstem dams. The other four dams – the Holyoke Dam (FERC 2004) and the three dams associated with the 15 Mile Falls Hydroelectric Project (FERC 2077) were relicensed relatively recently and Federal Energy Regulatory Commission (FERC) included in each licensing order for those projects a host of comprehensive environmental measures to benefit the public and the shared natural resources associated with the Connecticut River. The FERC has clearly and appropriately recognized the importance of taking a comprehensive look at the current group of Connecticut River relicensings as evidenced by its decision to hold joint site visits, joint Scoping meetings and a Cumulative Effects Meeting as part of the Scoping process; only the third time FERC has done so in a relicensing proceeding.

The U.S. Department of the Interior (DOI) has also recently recognized the importance of the Connecticut River by designating it as the nation's first National Blueway on May 24, 2012. Secretary Salazar noted that "The Connecticut River Watershed is a model for how communities can integrate their land and water stewardship efforts with an emphasis on 'source-to-sea' watershed conservation [as we] seek to fulfill President Obama's vision for healthy and accessible rivers that are the lifeblood of our communities and power our economies." Among the stated goals are to advance a whole river and [utilize] a water-based approach to conservation, outdoor recreation, education and sustainable economic opportunities in the watersheds in which we live, work and play."

The National Blueways System is part of the America's Great Outdoors Initiative which seeks to establish community-driven conservation and recreation for the 21st century. Both the DOI and the Department of Agriculture identified the Connecticut River as an important priority under America's Great Outdoors. The Connecticut River and its 7.2 million-acre watershed includes National Forests, National Historic Sites, National Wildlife Refuges, National Scenic Byways, Partnership Wild and Scenic Rivers, National Recreation Trails, National Natural Landmarks, Important Bird Areas, and segments of the New England National Scenic Trail; the Appalachian National Scenic Trail; the East Coast Greenway Trail; the Northern Forest Canoe Trail; Revolutionary Route National Historic Trail, a Ramsar wetland site, and an American Heritage River, and approximately two million acres of public and private conservation land.

The relicensing of the five projects in the subject proceedings offer a once in a generational opportunity to move forward in achieving the goals of the National Blueways System and the Administration's America's Great Outdoors initiative. Together, the projects currently undergoing relicensing impound over 90 miles of formerly free-flowing river and affect river resources from roughly 45 miles above the Wilder Dam downriver almost all the way to the upper reaches of the Holyoke Dam impoundment. The river offers myriad paddling opportunities for canoeing, kayaking and rowing, including multiple-day trips. It flows through many population centers, both urban and rural and is easily accessible to millions of people. However, serious obstacles to multi-day paddling trips: Several of the dams offer either no portage, as at Turners Falls and long and dangerous portages around other dams such as at Bellows Falls. Public access points and campsites (both river and shore access) are limited and inadequate to accommodate a reasonable amount of public recreational use.

Land Protection

Although the PAD identifies licensee owned lands within the project boundary, it does not so identify licensee owned lands adjacent to the project boundary. In some cases, these adjacent lands could be appropriate for providing additional recreational access to the river, new trails or connections to existing trails. Permanent protection of these lands would also confer aesthetic benefits to those using the river by providing views from the river of undeveloped lands. Regarding lands within the project boundary, those not integral to project operations should be permanently preserved and in many cases consist of prime agricultural lands. Even those lands currently under Agricultural Preservation Restrictions are only temporarily protected. Permanent protection ensures the long term viability of these important resources. Numerous non-governmental organizations (such as the Vermont Land Trust, the Upper Valley Land Trust, New Hampshire Audubon, the Society for the Protection of New Hampshire Forests and the Connecticut River Watershed Council) as well as the respective State Comprehensive Outdoor Recreation Plans (SCORP) of both New Hampshire and Vermont have identified valuable and important land protection locations and opportunities along the Connecticut River. This information should be identified and used collectively to determine appropriate opportunities for land protection in the context of these relicensing proceedings.

Comments and Issues Specific to Individual Projects

Identification of issues is set out below followed by specific study requests and justifications.

Obstacles to Multi-Day Paddling

The licensee's PAD cited the current New Hampshire SCORP (2013-2018) and the Vermont SCORP (2005-2009), both of which identified the need for "water-based" recreational activities. The New Hampshire SCORP specifically focused on the need for a "well-connected and maintained system of trails," including water-based ones. Multiple-day paddling trips clearly meet such needs, but are limited by the operations of the hydropower dams. Although campsites and boat ramps do exist, the dams and existing portages discourage paddlers seeking to navigate the length of the Connecticut River. Just as fish are challenged by multiple obstacles to their passage, paddlers are similarly discouraged and either abandon their efforts to migrate downriver or more likely do not even consider such a through trip. The licensee's PAD does not propose and measures to mitigate limits to or enhance the opportunities for multiple-day paddling trips.

Vernon

The portage trail at Vernon poses a number of challenges for paddlers. According to a paddler's comment at the Scoping meeting "Getting out of the river just before the dam is a mess. I've done this 5 times and it's always a mess—junk in the cove, trash, etc." In addition, the pathway to exit the river is steep and the landing is often muddy. A recent study by the Connecticut River Paddler's Trail (CRPT) documented the poor condition of the Stebbins Island campsite maintained by TransCanada just below the Vernon Dam. The CRPT notes that the ideal frequency of canoe campsites on flatwater rivers is one for every five river miles, accompanied by canoe and kayak access in every town. The Vernon facility does not provide enough campsites to meet that standard.

Bellows Falls

The existing portage trail at Bellows Falls is 1.5 miles long, and for most of that distance follows the breakdown lane of a high-speed state highway, New Hampshire Route 12. The Connecticut River Paddler's Trail guidebook to the river suggests that TransCanada can send a truck to pick up paddlers, but the licensee no longer provides that service. At one point the sidewalk or breakdown lane ends, vehicles create gusts of wind as they pass threatening to pull paddlers and boats onto the highway. The put in also involves steep rocky steps.

The existing trailered boat launch facility above the Bellows Falls dam is oddly configured, challenging to maneuver a trailer into and out of and leads directly into a narrow cove which is often silted in and leaves little room for error. The applicant should undertake a thorough evaluation regarding how to remedy this situation. The photo below at left shows the ramp and at right is a view of the narrow cove into which boats must be launched.

Wilder

The construction of the Wilder dam submerged 2.5 miles of significant rapids known as Olcott Falls which will not be replaced. The portage trail (shown in photo below) at Wilder Dam is long, steep, and dangerous for canoeists. Once at the bottom of the steep stone stairway, they must traverse and area similar to a sandbox mixed with football-sized stones. A shorter and safer path could be located on the opposite side of the river.

Sumner Falls, also known as Hartland Rapid, can be found seven miles below Wilder Dam. It is a series of ledges sprawled across a wide section of the Connecticut River that creates a whitewater play spot of approximately one-quarter mile. There are many surfing waves and the area is an excellent place for training beginning boaters and for play boaters. A large eddy on river right allows boaters to easily paddle back upriver and repeat the run. At generational and higher flow levels this site provides excellent surfing and currents for squirt boating. At moderate flows the run provides opportunities to complete a wide array of acrobatic tricks called freestyle paddling. However, there is a steep and challenging portage trail for paddlers not wishing to run the rapids. This trail cold certainly be improved and additional amenities could be added such as potable water, toilets, and campsites that would be used by play boaters at Sumner and by paddlers engaged in multiple-day trips on the river. However, the rapids at Sumner Falls are located seven miles downstream and could provide significant recreational opportunities. It is a popular kayak play spot used by paddlers from a wide region.

2. **Opportunities for Whitewater Paddling Enhancements at Bellows Falls**

The Bellows Falls project contains a .7-mile diversion that reduces in-stream flows other than for leakage. Any potential natural boatable flows during spillage are inaccessible, high, flashy, unpredictable, and are only available during periods of seasonal high spillage due to flooding. Even during natural spillage events, access to the reach is unavailable. Near the bottom of the reach, a low-head weir was installed which makes paddling additionally hazardous. Should whitewater boating in the bypassed reach be found feasible and required by the FERC, the licensee should be required to remove the low-head weir that now serves no function under the railroad bridge at the bottom of this reach.

Whitewater paddling opportunities eliminated by the project could be restored by the development of a whitewater park. The Bellows Falls bypass reach is a prime opportunity to create such an opportunity that could be of enormous economic value to the Bellows Falls, Vt., and Walpole, N.H., communities, as well as the wider region. During the Scoping meetings for Bellow Falls, representatives of the City enthusiastically supported the idea of looking into the activity. A professional designer of such parks—one with river engineers who have experience in constructing whitewater parks—should be hired to assess the opportunities.

In addition to recreation and aesthetics enhancements, the opportunity for controlled releases for whitewater boating with moderate, stable, and predictable whitewater flows could be made available from the late spring through early fall.

3. Preservation of Cultural, Historical and Educational Resources

Vernon

Dating to 1909, the Vernon Dam is the oldest of the Connecticut River dams currently seeking new licenses. It was the first hydroelectric dam to ship electricity overland to mills and customers not directly connected to the hydroelectric facility. The high line was the first of its kind. Educational opportunities should be coordinated with recreational improvements. A possible option identified during the Scoping meetings is to improve interpretative signage relative to the historical significance of the dam and high line transmission facilities. Records associated with the construction of the Vernon Dam (engineering studies, drawings, and photographs taken during construction) are of historical importance and should be preserved.

Bellows Falls

The first bridge across the Connecticut River was built on project lands, and Indian pictographs are visible on the rocks of the bypass reach. The dam was constructed in 1928 and is therefore old enough to be eligible for listing on the National Register of Historic Places. The canal associated with the dam is of itself highly significant, being the first such canal built in the U.S.

The current relicensing offers an opportunity to collect, catalogue and preserve important historical records held by the licensee related to the design and construction of the hydropower facilities. A study should determine what historical records remain, make suggestions for their safe storage, and suggest improvements at the projects to highlight the historical significance of each facility.

Study Requests Pursuant to 18 CFR 5.9(b).

These studies should include an analysis of why members of the public do not use certain resources associated with the Connecticut River in the project vicinity. As heard repeatedly during the scoping meetings, there is a lack of adequate recreational facilities on the Connecticut River in the project areas. This likely results in the cumulative displacement of use to other facilities in the watershed, possibly causing overcrowding at those resources. Although FERC's Form 80 is done every 6 years by the licensee, there is no requirement to do any evaluation other than user identification through on site surveys; therefore, considerable use is missed depending upon numerous factors such as survey dates, weather and conditions. There is also no requirement to survey or reach out to known user groups.

The standard recreational use studies identify current users captured during the study period on specific days; they do not attempt to identify users and more important, user groups/organizations that regularly (or for events) utilize project resources and adjacent lands. In order to develop a complete picture of user needs and goals, the applicant needs to identify local, state and regional user groups (through their mailing/membership lists/web sites info) and reach out to those people through mails and/or online surveys to identify user preferences and concerns. An on-site survey also does not address why certain users do not utilize and area, which may be due to overcrowding or lack of desired facilities. Among the user groups that could be so utilized are the Connecticut River Watershed Council, the Appalachian Mountain

Club (AMC), American Rivers, American Whitewater, WMCC and New England FLOW, to name just a few, along with the commercial outfitters and facilities on the river. Any organization that attended the scoping meetings or which provides comments or study requests should be so utilized for this purpose.

Conducting the necessary studies and implementing the measures needed to ensure the public has access to quality outdoor recreational resources are in the public interest. It is widely accepted that outdoor recreation offers significant benefits to the public. Outdoor recreation also has proven economic benefits for communities located near recreational resources.

1. Study of Project Facilities to Support Multiple-day Self-Powered Boating Trips on the Connecticut River

The NPS requests a study of the quantity, quality, and adequacy of land-based facilities operated by the licensees and associated with self-powered boating on the Connecticut River. This study should examine put-in and take-out facilities especially for canoes, kayaks, rowing shells and other self-powered watercraft; portage routes; campsites; parking and road access; seasons of operation of the facilities to match with actual river use; maintenance; water supplies and other amenities at campsites; and trash and sanitary facilities. The study should include a projection of usage during the proposed 30-year life of the licenses, and the opportunities for the project owners to buy land and/or interests therein from willing sellers in order to increase recreational benefits.

The study should examine the facilities that are necessary specifically for canoe, kayak and rowing shell access to the river. Information from the Vermont and New Hampshire SCORP study and from other river recreational interests suggests that interest in quiet water paddling is rising along with the sales of sea kayaks, rowing shells and canoes. Most of the existing facilities were designed for day use by motorboats with hard-surfaced ramps which may not be particularly suited to canoeists, especially those using wood-and-canvas or fiberglass canoes.

Paddlers attempting source to sea trips report challenging portages and limited opportunities for camping. According to the Connecticut River Paddler's Trail organization, the ideal frequency of canoe campsites on flatwater stretches is one every five river miles, along with canoe and kayak access in each town. Campsite amenities provided by the licensee should be well signed for visibility form the river and standardized to include adequate canoe landing sites, toilets, potable water, trash disposal, picnic tables, and tent platforms or three-sided shelters.

The study should include both water and land-based trails. The Connecticut River Paddler's Trail and the Connecticut River Birding Trail cross project boundaries and their collective interests should be included to ensure a watershed viewpoint, especially as it involves trail networks and associated facilities. Project lands at all the facilities, as well as adjacent lands should be studied for recreational and conservation improvement opportunities. In some cases, certain project lands could be added to existing public facilities (provided adequate resources are available to ensure appropriate long-term management) or placed under permanent conservation restrictions in order to improve conservation and recreation. The study should evaluate the adequacy and maintenance of existing trail systems for the term of the new license to be issued, and determine opportunities for additional hiking trails on project lands, and for linking those trails to existing trails. Such trails in the watershed could cross project boundaries, and adding to them could involve requiring the licensee to purchase additional land or interests therein.

Significant additional information relative to the use of the Connecticut River in the project areas exists, yet has not been included or evaluated in the PAD. There is inconsistent knowledge regarding multiple-day trips on the Connecticut River. Although the PAD lists facilities which are not owned or operated by the licensee, such as commercial operations, there is a lack of consistency about those facilities in terms of their seasons of use and what amenities they provide for public recreational use.

Several publications are widely used by paddlers and recreationalists. The primary source of information is *The Connecticut River Boating Guide: Source to Sea* (3rd ed.) published by the Connecticut River Watershed Council (2007). Recreational maps and guides to the river have been published for some reaches by KM Digital Productions in South Hadley, Mass., and are available from the Connecticut River Watershed Council. These foldout river maps cover the reaches from Vernon, Vt., to Turners Falls, Mass. (2008). Three other similar maps cover segments from Turners Falls (2007) down to Hartford, Conn. (2010), which is about the extent of the tidal zone. Most of those maps are in need of updates. In 1991, New England Cartographics in Amherst, Mass., published the *Connecticut River Guide in Massachusetts* by Doug Greenfield and Christopher J. Ryan. The Connecticut River Birding Trail organization located in White River Junction, Vt., has published maps detailing the upper valley section, the northern section, and the southern section of the river.

The Connecticut River Paddler's Trail prepared *The Connecticut River Paddler's Trail MA-CT Expansion Feasibility Study* in 2013. In that document, Noah Pollock of the Vermont River Conservancy examined the Massachusetts and Connecticut reaches of the river. The *Connecticut River Paddler's Trail MA-CT Expansion Feasibility Study* contained a map of the river in Massachusetts created by the Trust for Public Lands with dots indicating recommended locations for additional campsites.

The study identified above will provide the defining mechanism for identifying sites that can be improved as well as additional sites that should be developed in order to ensure increased public opportunities and desire by currently discouraged users to participate in multi-day and local paddling trips on the river. The study will serve to identify potential properties whose acquisitions or fee or interests therein may provide appropriate opportunities for additional recreational facilities. The study should also serve to identify indirect effects of the hydro facilities that may be discouraging public use or displacing water-based recreation to other parts of the watershed. Cumulative effects would also be evaluated given the number of dams on the river and the fragmenting effect they have on recreational use and experiences.

Studies to evaluate the adequacy of public resources and recreational uses and needs are standard throughout the hydro relicensing process. Methodologies can be selected from among the recognized and accepted standards of the resource and public planning fields. Surveys of people who do NOT use the river or are displaced can employ randomized samples from several databases associated with various local, regional and national user groups. Sufficient information is available from the guidebooks and maps of the river that identify access points and campsites, as well as information contained in the PAD. Once a consultant is selected and approved, the information should be gathered and analyzed in a timely manner. The study would require spring, summer and fall seasons in order to locate river users and develop a statistically adequate sample. A consultant with experience in similar projects should be selected, in part to create relevant comparisons to other hydropower projects around the country.

Because there is no comprehensive text or guide that provides current information regarding carrying capacity of river-based recreational facilities associated with both individuals and groups of paddlers, the above described study will serve to bridge this information gap as well as to identify needed reconstruction or expansion of existing facilities or the development of new facilities. Any field research would need to be correlated with future use projections and standard requirements for water based access, campsites, sanitary and picnicking facilities and portages. Although the New Hampshire SCORP is up to date and provides valuable information relative to that state's recreational facilities, recreational uses, needs and opportunities, the Vermont SCORP is relatively out of date and the study outlined above will serve to fill important information gaps.

2a. Controlled Whitewater Flow Study in the Bypass Reach Below the Bellows Falls Dam With Potential for Development of a Whitewater Park

The Bellows Falls project contains a .7-mile diversion that reduces in-stream flows except for minimum flow and during flood events. Natural boatable flows are frequently inaccessible, high, flashy, unpredictable, and are usually available only during periods of seasonal high spillage due to flooding.

Whitewater opportunities eliminated by the project could be partially restored if the licensee provided moderate, stable, and scheduled whitewater flows in the bypass reach that could be used from the late spring through early fall. The current operation of the project largely eliminates valuable seasonal paddling opportunities.

2b. Controlled Whitewater Flow Study at Sumner Falls

Wilder Station would release prescribed flows for this test. When the flows reach Sumner Rapids, a selected group of paddlers would run the rapid and then answer written questions about their experiences at that flow level. Wilder Station would release three or four or possibly several different flows, measured in cubic feet per second, and the paddlers' experiences would be analyzed to determine the flows that work best at the rapid.

Controlled flow studies are routinely ordered to be conducted on FERC projects. These whitewater reaches offer a prime opportunity to restore a whitewater recreation that could be of enormous recreational and economic value to the community (in the case at Bellows Falls) and would be of high value to boaters in the region relative to Sumner Falls, an area which already sees a high volume of recreational use.

The goal of a whitewater flow study is to assess the presence, quality, access needs, flow information needs, and preferred flow ranges for river-based boating resources in a stepwise manner. The information to be obtained can be generally characterized as quantitative and qualitative descriptions of the following:

1. The range of optimal and acceptable flows for whitewater paddling in a whitewater park or natural falls setting.
2. The frequency, timing, duration and predictability of optimal and acceptable paddling flows under current conditions.
3. The access needs of whitewater boating use and the current and potential river access options for paddling.
4. The flow information needs of whitewater boating and the current and potential flow information distribution system.
5. The location, challenge, and other recreational attributes associated with specific rapids and other river features.

The information gathered is a combination of user-generated flow preferences and other engineering information on current and proposed operations (e.g. discharges), geographic information and basic recreational information. Essentially, the Bellows Falls Dam and Wilder Dam would release prescribed flows into the bypass reach for this test, perhaps over two days. For each release, a selected group of paddlers would run the rapid and then answer written questions about their experiences at each flow level. The dams would release several different flows, measured in cubic feet per second, and the paddlers' experiences would be analyzed to determine the flows that work best at the rapid.

The Bellows Falls bypass reach would likely offer the public a high-quality whitewater boating resource when flow conditions are suitable. Conducting the necessary studies and implementing measures to ensure public access to outdoor recreation are in the public interest. In addition, the dry riverbed is not generally considered to be aesthetically pleasing and is in full view of many people who pass by on nearby Route 12. The rapids at Sumner Falls could provide an already popular recreation spot with the additional benefits of play boating while improving access for through paddlers.

Restoration of whitewater recreational opportunities in the Connecticut River has the potential to offer the region economic benefits. Numerous whitewater flow studies have been conducted during FERC relicensings on New England's rivers (including the nearby Deerfield River) that have a long history of whitewater paddling use. According to the FERC, in order to fully evaluate the project's effect on whitewater recreation opportunities and to balance potential enhancement opportunities with their cost, a controlled-flow whitewater boating study is relevant to the Commission's public interest determination. This is especially true regarding the Bellows Falls bypassed reach. The potential high quality of this.7-mile long whitewater run should; therefore, be evaluated as should the opportunities for whitewater paddling at Sumner Falls.

Current and historic project operations leave significant information gaps and eliminate most of the low and moderate flows from the Bellows Falls reach, resulting in flows too low to paddle, too flashy, or consisting of spiking high flows that may be too dangerous to attempt.

Intermediate paddlers, commercial paddlers, and general river-runners know relatively little about this river reach at low or moderate flows. The use of a controlled-flow analysis has been described in Doug Whittaker, Bo Shelby, and John Gangemi, Flows and Recreation: A guide to studies for river professionals (2005), p. 26-29, is available from the National Park Service website at: www.nps.gov/hydro/flowrec.pdf . The goals include evaluating this stretch of river for use as a whitewater park, and evaluating the flows at which the run could best be utilized. In this case, river engineers with experience constructing whitewater parks, such as the McLaughlin Whitewater Design Group of Denver, Colo., should participate in designing the controlled-flow study.

Project operations eliminate most of the paddling days each year, including the virtual elimination of valuable and regionally needed summer paddling opportunities. This bypassed reach could be a high-quality paddling resource, and since paddling is a flow dependent activity, the project directly affects paddling on the Connecticut River, thereby providing a direct nexus. The results of a controlled flow study would help determine the need for license requirements for scheduled whitewater releases.

The study requests in the Bellows Falls bypass and at Sumner Falls should follow the standard methodology as described in Whittaker, referenced above. This methodology is designed to gather information to assess the presence, quality, and preferred flow ranges for river-based boating resources in a step-wise manner. The process steps are generally 1) desktop analyses, 2) on-land feasibility assessment, 3) on-water single flow assessment, 4) on-water multiple flow assessment. We expect and request the full implementation of this methodology.

Because the quality and flow needs of the resource are unknown, the NPS requests that an on-water multiple flow assessment be conducted. This study will need to take place on various dates and at variable flow levels throughout a spring and summer. Boating groups (such as American Whitewater, NEFLOW and the AMC) can work with the licensee to document the known information regarding the river and would help provide volunteer paddlers and technical support for the studies as appropriate. The whitewater boating study methodology identified above has been used on dozens of other FERC regulated reaches. This study should include an examination of the access issues for the bypass reach and the take-out below. The whitewater boating community would work with the applicant to keep costs reasonable and the quality of information high. Prior to conducting paddling runs in the bypass reach, the licensee should remove the small low-head weir at the base of the run and restore the natural shape of the river in consultation with whitewater engineers. A collaborative approach sought by the paddling community including in-kind contributions of time and expertise should help consultants complete these studies on behalf of the licensee for a reasonable cost.

The studies will require integration of known information followed by an organized flow study during which several flows are paddled by boaters, with still image and video documentation, surveys of the boaters, a guided conversation among the boaters, and a written report. Given that this is a bypass reach with some minimal access and relatively straightforward hydrology, and given the collaborative approach sought by the paddling community, including in-kind contributions of time and expertise, a consultant should be able to complete this study on behalf of the licensee for a very reasonable cost.

The potential for developing a new, high quality whitewater park as a recreational facility is a new idea, but is exactly the type of idea that often emerges from the Scoping process. Representatives of Bellows Falls and nearby Lebanon, New Hampshire were quite enthusiastic about looking into this idea and it is similar to numerous such proposals to have come out of other FERC Scoping process, many of which have come to fruition. However, current and historic project operations provide no information and have virtually eliminated all stable, low and moderate flows within the bypassed reach. Spiking flows on the order of 50,000 cfs are not uncommon, but intermediate paddlers, commercial paddlers, and general river-runners know little about this bypass reach under any flow conditions. This study will determined if there is adequate potential to build a whitewater park that offers a quality whitewater resource with safe and adequate put-in, take-out, and return facilities that allow for use of the entire bypass reach. The Bellows Falls dam diverts the entire flow except during flood events and normal seepage resulting in the elimination of a possible valuable and regionally rare urban summer paddling opportunity. Therefore, the project nexus is direct and the study results may support license requirements to develop a whitewater park and provide scheduled releases in the bypass reach.

The NPS recognizes that scheduled or regular flows into the bypassed reach impact power generation, fish passage, and other environmental variables and should be examined in the broader context. Therefore, the establishment and construction of a whitewater park with possible fish passage should thoroughly evaluate design standards such as those developed by the McLaughlin Whitewater Design Group or similar firm which has worked extensively with municipalities, public utilities, the U.S. Army Corps of Engineers, and paddling groups throughout the United States. The analysis should recommend whitewater structures to improve the run, and the work required to construct public access put-in, take-out return shuttle facilities for boaters, and possible additional fish passage.

The PAD proposes no whitewater feasibility analysis. This no-action step will reveal nothing about the project impacts on whitewater recreation or opportunities for protection, mitigation, or enhancement measures. There is currently no information relative to the relationship between specific low and moderate flows and the paddling experiences they might provide. A desktop analysis cannot generate this information. Without this information, the FERC cannot fully evaluate or define the project impacts, nor propose and consider provision of releases that provide targeted recreational experiences and related economic benefits to the host community and the region.

3. **Preservation of Cultural, Historical, and Educational Resources**

A study should be undertaken to determine a variety of options for educating the public about these historic dams, and to determine what actions should (or should not) be taken to preserve artifacts and provide education. This study should also address the need to document, catalogue, preserve and where appropriate, display the work of the engineers who built the Dams. Vernon, constructed in 1909 was the first dam to ship electricity to remote locations and shipped electricity to the mills of Massachusetts, thus playing a role in the labor history of the United States. The site of the Bellows Falls Dam is where the first bridge across the Connecticut River was constructed along with the earliest canal in the U.S. Similar historic resources are likely associated with construction of the Wilder Dam.

Historic resources including drawings, photographs, blueprints, inventories and plans should be considered historical resources worthy of preservation for the public benefit. The engineering records related to the construction of the dams are a valuable element of our social and industrial history. The licensee currently possesses roughly two dozen scrapbook volumes of these records and photos. Each volume is numbered, but the numbers suggest there may be a total of 300 or more scrapbooks in existence. The study should discover what records remain and recommend plans for permanently preserving them and making them available to historians and researchers.

This relicensing proceeding can provide assistance to visitors, schools, and river travelers to better understand the remarkable history of the Projects and the area. It offers perhaps the last chance to rescue important historical records held by the licensees related to the design and construction of the hydropower facilities. The study should determine what historical records remain, make suggestions for their safe storage, and suggest improvements at the projects to highlight the historical significance of the facilities.

The information to be gathered pertains to the original construction of the three dams and might also offer valuable insight into the pre-dam condition of the river and its environs. The nexus is direct as the licensee currently possesses scrapbooks, photographs, construction plans, and other historical records related to the construction of the dams. Preservation of such documentation should be a license requirement.

For assistance, the licensee would work with the New Hampshire Division of Historical Resources and the Vermont State Historic Preservation Office whose staffs could recommend how to best handle and preserve the scrapbook records and other historical information about building the dam. The work involved to locate the records owned by TransCanada would be internal, with advice and recommendations provided by professional historians once the scope and location of the documents is determined.

4. **Creation of a Decommissioning Fund**

The NPS believes a study of the financial production of each individual facility that is being relicensed is appropriate. The analysis and/or NEPA document to be prepared should evaluate creating an escrowed decommissioning or trust fund for the dam and pumped storage project. Given that both parent companies of the licensees are foreign owned, deregulation, future ownership changes and the potential financial impacts of climate change can affect the financial health of the current and potential future owners. The licensees, not the public, should not be burdened with potential costs associated with decommissioning. FERC license conditions often address additional mitigation such as trust funds, dam decommissioning funds, and public committees to oversee license implementation. To that end, the NPS requests a study of both the fiscal health of each TransCanada facility on the river and recommendations for the creation of a decommissioning fund or trust fund to protect the public interest.
New England's rivers are littered with abandoned dams. Over the centuries, companies have failed, and weather events or human error have crippled dams that were then simply left behind.

Although the owners of these facilities are presently in good financial health and can meet the requirements over the life of a new license, times and circumstances can change. Unforeseen events might cause either business or physical failure. A number of extraordinary storm events (such as Hurricane Irene and several extreme drought, rain and snow events) have occurred in New England in recent years, thereby increasing the need to fully evaluate a potential dam failure and the associated costs. International business remains risky and both TransCanada and FirstLight are foreign owned. Changing foreign regulations, currency devaluations or circumstances completely out of FERC's purview could compromise the health of the licensee. The economic security of a federally licensed hydropower dam on the longest river in New England is clearly in the public interest. Many hydropower projects support robust recreation economies and produce a public good by generating renewable forms of electricity. The historical record demonstrates—by the thousands of abandoned dams on New England's rivers—that the public should not accept the burden of industrial failure, especially associated with dams. It has become common to create decommissioning funds at such federally licensed facilities as a way of insuring the public interest against having to pay for removal of a damaged facility or to take over from a failed corporation. Therefore, the American public should be insured against the burden of decommissioning costs. A study could examine the health of the facilities and their owner and recommend the terms of a license requirement for decommissioning.

There is a direct nexus between Project operations and the economic viability of each individual dam. Study results could lead to a license requirement setting up an escrowed decommissioning or trust fund to protect the public interest. The financial viability portion of the study would follow normal procedures in accounting and financial management. The study itself would be relatively inexpensive; however, adequately funding the trust would more challenging. The NPS is unaware of alternative means of securing the public from risks that the corporations or the physical assets might fail during the course of the federal license.

Conclusion

The National Park Service appreciates the opportunity to comment on the PAD and to present study requests we believe to be in the public interest. NPS Hydro Program staff will remain available throughout the course of these proceedings to assist the applicant, other resource agencies and non-governmental organization in the development, conduct and evaluations of the studies requested. Questions or comments on this submittal should be addressed to Kevin Mendik at kevin_mendik@nps.gov or by phone at 617-223-5299.

Respectfully submitted,

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P-1892-026

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AMERICAN WHITEWATER
P.O. Box 1540 Cullowee, North Carolina 28723

TransCanada Hydro Northeast, Inc. Wilder Hydroelectric Project No. 1892-026

NEW ENGLAND FLOW AND AMERICAN WHITEWATER'S COMMENTS AND STUDY REQUESTS

New England FLOW is a regional non-profit organization whose affiliations have represented whitewater boaters, canoeists, rafters, and other river users on multiple project re-licensings throughout New England for over twenty-five years. American Whitewater is a national non-profit organization dedicated to protecting and restoring our nation's whitewater resources and enhancing opportunities to enjoy them safely.

Seven miles downstream from Wilder Dam, located in Hartland, Vermont, lies a river reach known as "Sumner Falls." It is sometimes called "Hartland Rapids" and is a series of ledges sprawled across a wide section of the Connecticut River that creates a whitewater run of approximately ¼ mile.

The original Olcott Rapids at the site of Wilder Dam have been drowned by the Project. We recommend a study of off-site whitewater tributaries as potential mitigation.

If regularly scheduled flows of varying frequency were provided, the recreational use of the resources at this project have the potential to add significant economic value to the region, ,New Hampshire.

Issue #1: Impacts of Wilder Dam on the Connecticut River flows and on recreational paddling at Sumner Falls.

The Wilder Dam itself has drowned three rapids, over a stretch of one mile, originally known as Olcott Falls and limits use of other rapids known as Sumner Falls.

Issue # 2: Camping and sanitary facilities available for multiple-day kayaking or canoe trips.

While the applicant has itemized 9 camping facilities and 17 access points available throughout the reach from the Wilder Dam upstream to the 15-Mile Falls Dam, they have not provided a qualitative analysis of these facilities.
In the PAD, the Licensee proposes no new camping sites or upgrades to existing facilities, nor do they propose any management plans for maintenance or enforcement.

Issue #3: Economic analysis.

The flow operations and management of the Wilder Dam have significant negative recreational impacts and related socio-economic impacts.

Issue #4: Alternatives for off-site mitigation.

Wilder Dam sits atop a whitewater falls and its reservoir drowns two other whitewater runs within one mile of the dam. Alternatives in the form of off-site mitigation could create compensatory whitewater opportunities.

Study Requests

1. We request a "Controlled Whitewater Flow Study" for the Sumner Falls Reach.

The Licensee PAD proposes no whitewater feasibility analysis and this no-action step will reveal nothing about the project impacts on whitewater recreation at Sumner Falls or opportunities for protection, mitigation, or enhancement measures.

2: We request a study of the adequacy of camping, sanitary and other facilities such as portages available for multiple-day kayaking or canoe trips.

There are multiple sites along the Connecticut River that are used as access points or have camping facilities. However there are vast differences in the ability or capacity of these sites to handle paddling groups of varying size and numbers or sanitation needs.

3: We request an economic analysis for the site recreation potential.

Since the present economic values are unknown because of restricted recreational activity resulting from the construction of Wilder Dam, we request the study be compiled using the *"contingent valuation"* study method that measures individuals' *"willingness to pay."*

These values can then be compared to power generation values, and extrapolated to develop an understanding of economic benefits and how those dollars will be multiplied throughout the community as benefits associated with paddling activities.

4. Compensation for Impacts of Lost Whitewater Recreation at Wilder Dam

The goal of this study request is to assess the presence, quality, access needs, flow information needs, and preferred flow ranges for regional whitewater boating resources that would provide adequate compensation for the loss of whitewater recreation at the Wilder Dam. Rivers in the region that would be candidates for such off-site mitigation would be the West and Winhall Rivers in Vermont, the Millers and Deerfield Rivers in Massachusetts, and the Ashuelot River and Otter Brook in New Hampshire.

The National Blueway concept takes a watershed viewpoint and addresses the river from its source to the sea. The National Blueways System has as its goal "to advance a whole river and watershed-wide approach to conservation, outdoor recreation, education, and sustainable economic opportunities in the watersheds".

Conclusion:

Restoration of recreation opportunities in the watershed of the Connecticut River has the potential to offer the region significant economic benefits. We respectively request the hydrological, recreational, and economic studies that will support the dialog and analysis regarding the flows and associated recreational values from the Wilder Dam project.

Respectfully submitted this _28th _ day of __January 2013

Thomas J. Christopher

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Document Content(s)

P-1855045

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AMERICAN WHITEWATER

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TransCanada Hydro Northeast, Inc. Bellows Falls Project No. P-1855-045

NEW ENGLAND FLOW AND AMERICAN WHITEWATER'S COMMENTS AND STUDY REQUESTS

New England FLOW is a regional non-profit organization whose affiliations have represented whitewater boaters, canoeists, rafters, and other river users on multiple project re-licensings throughout New England for over 25 years. American Whitewater is a national non-profit organization dedicated to protecting and restoring our nation's whitewater resources and enhancing opportunities to enjoy them safely.

The Bellows Falls bypass reach, the original riverbed of the Connecticut River, has the ability to offer paddling opportunities of sufficient quality through spillage events. This site would be a very good location to develop a whitewater park, and at moderate flows the run could be used by canoeists and kayakers for surfing waves and for acrobatic tricks called "freestyle" paddling.

Issue #1: Impacts of the Connecticut River flow diversion on recreational paddling at the Bellows Falls bypass reach.

The Bellows Falls project is a .7-mile diversion that reduces in-stream flows completely except for some leakage. Any natural boatable flows under flood spillage are inaccessible, high, flashy, unpredictable, and are only available during periods of seasonal high spillage due to flooding. Near the bottom of the reach, a low-head weir was installed that might make paddling hazardous.

Issue # 2: Public Access for whitewater boating, rafting, and canoeing is inadequate.

Directly below the Bellows Falls Dam there is currently no formal public access or parking for whitewater boaters or canoeists. In order to put in for access to the whitewater rapids in the bypass reach, boaters would need to descend a steep slope studded with large boulders from a heavily traveled roadway

Issue # 3: Camping and sanitary facilities available for multiple-day kayaking or canoe trips.

In the PAD, the Licensee has itemized 3 camping facilities and 11 access points (not all of which are maintained by TransCanada) in the reach from the Bellows Falls Dam to the Wilder Dam; however they have not provided a qualitative analysis of these facilities.

These sites are managed and/or maintained by multiple parties, and at a minimum there should be consistent standards for sanitation, safety, and control of litter or camping debris.

Issue #4: Economic analysis.

The diversion of flow around the Bellows Falls Dam has significant negative recreational impacts and related socio-economic impacts. By changing the operational scenario of the Bellows Falls Project and constructing a whitewater park, the potential exists to create new tourism products for a region that is primed to capitalize on it.

In this case, because of the significant economic potential of a whitewater park to increase recreation with increased flows, we believe FERC should also weigh the predicted economic values associated with the recreational use when looking at various alternatives.

Issue #5: Alternatives for off-site mitigation.

Bellows Falls Dam sits atop a whitewater falls, after which it is named, and its reservoir drowns other whitewater drops as the river approaches the dam. Alternatives in the form of off-site mitigation could create compensatory whitewater opportunities.

Study Requests

We hereby request several studies per 18 CFR 5.9(b).

1. We Request a Controlled Whitewater Flow Study in the bypass reach below the Bellows Falls Dam.

The goal of a whitewater flow study is to assess the presence, quality, access needs, flow information needs, and preferred flow ranges for river-based boating resources in a stepwise manner.

Thus, the information to be obtained for the whitewater park study is a combination of user-generated flow preferences and other engineering information on current and proposed operations (e.g. discharges), geographic information and basic recreational information.

Results of this study may produce evidence supporting mitigating license requirements for a whitewater park and scheduled releases in the bypass reach.

2. We request a study to provide public Access for whitewater boating, rafting, and canoeing.

The goal of this study is to identify and define adequate access points that provide trails and parking, at the beginning and end of the bypass reach.

As we explained above, the Bellows Falls bypass reach offers the public an opportunity to enjoy a high quality whitewater boating resource with the development of a whitewater park.

There is an inconsistent body of knowledge regarding access needs in this reach, and the PAD does not identify access points for any type of whitewater use.

Access would be necessary if a whitewater park were used as a mitigating license requirement.

3: We request a study to evaluate camping and sanitary facilities available for multiple-day kayaking or canoe trips.

The goal of this study is to provide a quantitative and qualitative analysis of existing facilities to determine their capacity to manage the increasing number of paddlers who are making multiple-day trips on the Connecticut River. The study should examine the adequacy of such facilities over the 30-year life of the license.

In the PAD, the Licensee identifies 11 sites within Project boundaries as access points to the Connecticut River, such as boat ramps or car-top access. However, none of these sites are designated for camping nor do they have sanitary facilities.

4: We request an economic analysis for site recreation potential.

We believe using the "contingent valuation method" of study to determine economic information based on recreational use will provide useful information that will eventually help establish the value for developing a whitewater park.

Economic stimulus is clearly in the public interest. Many examples of whitewater parks support robust recreation economies, including those that have been constructed in Charles City, Elkader, and Iowa City, Iowa, as well as South Bend, Indiana; Springfield, Ohio; Yorkville, Illinois; and Petoskey, Michigan.

5. We request a study to define compensation for impacts on the Connecticut River and loss of whitewater recreation below Bellows Falls Dam

The goal of this study is to assess the presence, quality, access needs, flow information needs, and preferred flow ranges for regional whitewater boating resources that would provide adequate compensation for the loss of whitewater recreation at the Bellows Falls Dam.

Thus, the information obtained could be used by the Licensee to obtain a combination of alternatives in the form of off-site mitigation and by cooperating with other state and federal agencies to develop compensatory whitewater opportunities.

Rivers in the region that would be candidates for such off-site mitigation would be the West and Winhall Rivers in Vermont, the Millers and Deerfield Rivers in Massachusetts, and the Ashuelot River and Otter Brook in New Hampshire.

The National Blueway concept takes a watershed viewpoint and addresses the river from its source to the sea. The National Blueways System has as its goal "to advance a whole river and watershed-wide approach to conservation, outdoor recreation, education, and sustainable economic opportunities in the watersheds".

Conclusion:

We respectively request hydrological, recreational, access, economic, and off-site mitigation studies that will support the dialog and analysis regarding the restoration of flows and associated recreational values to the bypass reach of the Bellows Fall project, and provide compensation for the loss of drowned whitewater habitat. All such studies should take into consideration a projection of the public's need for water-based recreation for the 30-year life of the proposed license.

In addition, in these comments we offer our written comments on the PAD, to better inform this relicensing process. Thank you for considering these comments.

Respectfully submitted this _28th _ day of __January 2013

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Document Content(s)

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

TransCanada Hydro Northeast, Inc.	Wilder Hydroelectric Project FERC No. 1892-026

NEW ENGLAND FLOW, AMERICAN WHITEWATER, AND THE APPALACHIAN MOUNTAIN CLUB'S COMMENTS AND STUDY REQUESTS IN RESPONSE TO THE NOTICE OF INTENT TO FILE LICENSE APPLICATION, FILING OF PRE-APPLICATION DOCUMENT (PAD), COMMENCEMENT OF PRE-FILING PROCESS, AND SCOPING: REQUEST FOR COMMENTS ON THE PAD AND SCOPING DOCUMENT, AND INDENTIFICATION OF ISSUES AND ASSOCIATED STUDY REQUESTS REGARDING THE WILDER HYDROELECTRIC PROJECT, FERC PROJECT NO. 1892-026.

New England FLOW is a regional non-profit organization whose affiliations have represented whitewater boaters, canoeists, rafters, and other river users on multiple project re-licensings throughout New England for over 25 years. American Whitewater is a national non-profit organization dedicated to protecting and restoring our nation's whitewater resources and enhancing opportunities to enjoy them safely. Since 1876, the Appalachian Mountain Club (AMC) has promoted the protection, enjoyment, and understanding of the mountains, forests, waters, and trails of the Appalachian region, and is the largest conservation and recreation organization in the Northeast with more than 90,000 members. All three organizations are "steering committee" members of the Hydropower Reform Coalition based in Washington, D. C. Our members, who are primarily conservation-oriented kayakers, canoeists, and rafters living in this area of the Northeast would enjoy this section of the Connecticut River as a weekend trip.

The original Olcott Rapids at the site of Wilder Dam have been drowned by the Project.

Pre-Construction Panoramic View of Olcott Falls Looking Toward New Hampshire Side

Other rapids looking upstream from Chase Island were lost as the impoundment filled with water.

The Wilder Dam Project on the Connecticut River has the ability to offer improved paddling opportunities of sufficient quality through spillage events. Seven miles downstream from Wilder Dam, located in Hartland, Vermont, lays a river reach known as "Sumner Falls." It is sometimes called "Hartland Rapids" and is a series of ledges sprawled across a wide section of the Connecticut River that creates a whitewater run of approximately ¼ mile. There are many "catch on the fly" waves and the area is an excellent place for training beginning boaters and for play boaters. At generational and higher flow levels this site provides excellent surfing and currents for squirt boating. At moderate flows the run provides opportunities to complete a wide array of acrobatic tricks called "freestyle" paddling. All manufacturers of kayaks design boats for this purpose.

Sumner Falls at Low Flow

If regularly scheduled flows of varying frequency were provided, the recreational use of the resources at this project have the potential to add economic value to the region, given its central location and its proximity to Dartmouth College, Norwich University, and the communities of Bellows Falls, Springfield, and White River Jct., Vermont, as well as Lebanon, New Hampshire.

All studies requested by New England FLOW, American Whitewater, and the AMC should contain projections for use by the public during the 30-50 year life of the proposed license, and the adequacy of all facilities and mitigation for that time period.

Issue #1: Impacts of Wilder Dam on the Connecticut River flows and on recreational paddling at Sumner Falls.

The Wilder Dam project is a 400-foot long dam that blocks flows completely except for a "*minimum* flow of 675 cfs or inflow, whichever is less." Any natural boatable flows have been eliminated because of the dam and are only available during generation or periods of seasonal high spillage and flooding.

Some of the opportunities eliminated at Sumner Falls by the project could be restored by the development of a release schedule that could provide flows of varying volume and could be used at Sumner Falls from the late spring through the early fall months. The current operation of the project impacts valuable seasonal paddling opportunities.

This recreation-flow relationship would need to be substantiated through both operational and recreational analyses. The correct context to conduct this inquiry is through the use of a "controlled-flow analysis," a stepwise methodology described in Whittaker, et al., *Flows and Recreation: A guide to studies for river professionals* (2005), as we formally request below.

In the PAD, the Licensee proposes no flow enhancement to mitigate the project effects on whitewater recreational use.

In addition to recreation and aesthetics, we recognize that flow-related decisions also affect economic factors related to power generation and other environmental variables, particularly fish passage. We look forward to exploring how all flow-related values relate to one another through participation in this relicensing process.

Issue # 2: Camping and sanitary facilities available for multiple-day kayaking or canoe trips.

Information provided by canoe clubs and other river recreational interests cite changing demographics and the rise of sea kayaking as reasons for high interest in flatwater paddling and multiple-day canoe trips.

In the PAD, the Licensee cites the Massachusetts SCORP (2006-2011), which indicated a need for "water-based" activities, and one of the goals of the New Hampshire SCORP identified the need for a variety of recreational opportunities. The Vermont SCORP (2005-2009) reveals the need for access to all types of outdoor recreation.

While the applicant has itemized 9 camping facilities and 17 access points available throughout the reach from the Wilder Dam upstream to the 15-Mile Falls Dam, they have not provided a qualitative analysis of these facilities. These sites are managed and/or maintained by multiple parties, and at a minimum there should be consistent standards for sanitation, safety, and control of litter or camping debris.

In the PAD, the Licensee proposes no new camping sites or upgrades to existing facilities, nor do they propose any management plans for maintenance or enforcement.

Issue #3: Economic impacts.

The flow operations and management of the Wilder Dam have significant negative recreational impacts and related socio-economic impacts. By changing the operational scenario of the Wilder Dam Project, the potential exists to create new tourism products for a region that is primed to capitalize on it. Retail activity, and food and lodging opportunities are geared toward non-commercial paddlers, and thousands of people who currently travel to the region each year for canoeing, rafting, kayaking and other outdoor adventure activities will discover added value to the region.

In making a public interest decision, FERC must weigh the value of water in the river against the restriction of flows held only for power generation, and then reach a comprehensive plan for the development of the river that strikes the appropriate balance and is best adapted to the river. In many dam relicensing proceedings the values of flow restoration are largely recreational and ecological, and thus hard to evaluate in dollars. In this case, because of the potential for increased recreational usage with increased and variable flows, we believe FERC should also weigh the predicted economic value associated with the recreational use when looking at various alternatives.

Issue #4: Alternatives for off-site mitigation.

Wilder Dam sits atop a whitewater falls and its reservoir drowns two other whitewater runs, including Olcott Falls and the former rapids upstream of Chase Island within three miles of the dam. Alternatives in the form of off-site mitigation at Bellows Falls or elsewhere in the Connecticut River watershed could mitigate for the loss of whitewater opportunities in the Wilder Dam project area.

Study Requests

We hereby request several studies per 18 CFR 5.9(b).

1. Controlled Whitewater Flow Study for the Sumner Falls Reach.

(1) Describe the goals and objectives of each study proposal and the information to be obtained.

The goal of a whitewater flow study is to assess the presence, quality, access needs, flow information needs, and preferred flow ranges for river-based boating resources in a stepwise manner.

The information to be obtained can be generally characterized as quantitative and qualitative descriptions of:

- The range of optimal and acceptable flows for whitewater paddling in a river setting;
- The frequency, timing, duration and predictability of optimal and acceptable paddling flows under current conditions, and how proposed alternative operations could be used;
- The access needs of whitewater boating use and the current and potential river access options for kayakers and other paddlers, as well as portage opportunities;
- The flow information needs of whitewater boating and the current and potential flow information distribution system;
- The location, challenge, and other recreational attributes associated with Sumner Falls rapid and other river features that may be available.

Thus, the information to be obtained for the whitewater flow study is a combination of user-generated flow preferences and other information on current and proposed operation (e.g. discharges), geographic information and basic recreational information.

Sumner Falls at low flow 2012. Connecticut River below Wilder Dam.

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.

The requester is not a resource agency.

(3) If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.

The Wilder Dam offers the public an opportunity to enjoy a quality whitewater boating resource at Sumner Falls. Conducting the necessary studies and implementing the necessary measures to ensure the public has access to quality outdoor recreational resources is in the public interest. It is widely accepted that outdoor recreation has significant benefits to participants, including health, well being, and quality-of-life. Outdoor recreation also has proven economic benefits for communities located near recreational resources.

Restoration of recreation opportunities in the Connecticut River and its tributaries has the potential to offer the region significant economic benefits. FERC has concluded that *"to fully evaluate the project's effect on whitewater recreation opportunities and to balance potential enhancement opportunities with their cost, a controlled-flow whitewater boating study is relevant to Commission's public interest determination."* This is equally true regarding the Sumner Falls reach on the Connecticut River.

The Licensee owns and operates several river access areas on the Connecticut River within project boundaries, and both the states of Vermont and New Hampshire manage additional sites in the vicinity of the Project. Thus, there is a clear interest in the public's ability to traverse the Connecticut River in boats and to develop recreational uses. In addition to this interest, the Connecticut River has been designated as America's first *"Heritage River"* and *"National Blueway."* Please see comments under Study #5 below concerning the National Blueway designation and its relationship to agencies.

(4) Describe existing information concerning the subject of the study proposal, and need for additional information.

While many controlled-flow studies as described above have been conducted on New England's rivers (Deerfield in Massachusetts, and Kennebec and Rapid in Maine) that have a long and illustrious history of whitewater paddling use, flows on this section of the Connecticut River have been fractured and are undependable. The potential of developing a quality river reach at Sumner Falls as a recreational facility and destination should not be ignored.

Current and historic project operations, however, provide no consistent releases or meaningful information for this reach. The result has been flows too low to paddle, or flashy, spiking high flows that flatten out the rapids. It should be determined what flows are best suited for maximum recreational use.

(5) Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

The Project controls the entire flow in the Connecticut River with the exception of releasing the required minimum flow of 675 cfs or when generating. The result is chaotic and unpredictable timing for paddlers wishing to recreate at Sumner Falls, and the elimination of valuable and regionally needed summer paddling opportunities. The Connecticut River can be a high quality paddling resource, and since paddling is a flow dependent activity, the project directly affects paddling on the Connecticut River. The project nexus is direct. The results of a controlled flow study would help determine the need for license requirements for whitewater releases.

(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

We request that the licensee conduct a controlled-flow study on the Sumner Falls reach of the Connecticut River. The study should follow the standard methodology as described in Whittaker et al., cited above. This methodology is designed to gather information to assess the presence, quality, and preferred flow ranges for river-based boating resources in a step-wise manner. The process steps are generally 1) desktop analyses, 2) on-land feasibility assessment, 3) on-water single flow assessment, 4) on-water multiple flow assessment.

We will work with the licensee to document the known information regarding the river. We will provide volunteers and technical support for the study as appropriate. We hope to work collaboratively with the licensee on this study. The whitewater boating study methodology we have requested has been used on dozens of other FERC regulated reaches.

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

We are willing to work with the licensee on the whitewater paddling controlled-flow study to keep costs reasonable and the quality of information high. Any information that is already known can jump-start the study process and avoid un-needed effort. What will be subsequently needed is the integration of this information and then an organized flow study during which several flows are paddled by boaters with still image and video documentation, surveys of the boaters, a guided conversation among the boaters, and subsequently a written report.

Given that this is a main stem reach with access and relatively known hydrology, and given the collaborative approach sought by the paddling community, including in-kind contributions of time and expertise, consultants should be able to complete these studies on behalf of the licensee for a very reasonable cost.

The Licensee PAD proposes no whitewater recreation mitigation analysis, either on-site or off-site.

2: Camping, sanitary and other facilities such as portages available for multiple-day kayaking or canoe trips (Recreation Use and Needs).

(1) Describe the goals and objectives of each study proposal and the information to be obtained.

The goal of this study is to provide quantitative and qualitative analyses of existing facilities to determine their capacity to manage the increasing number of paddlers who are making multiple-day trips on the Connecticut River. This study should also identify other points on the river that would be suitable for the establishment of additional facilities, their adequacy to meet demand for the period of a 30-50 year license, and opportunities for the power company to acquire additional lands to meet the projected need.

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;

The requester is not a resource agency.

(3) If the requester is a not resource agency, explain any relevant public interest considerations in regard to the proposed study.

In the PAD, the Licensee cites the Massachusetts SCORP (2006-2011), which indicated a need for "water-based" activities, and one of the goals of the New Hampshire SCORP identified the need for a variety of recreational opportunities. The Vermont SCORP (2005-2009) reveals the need for access to all types of outdoor recreation.

The public has an interest in healthy rivers and streams that fully support the full suite of beneficial uses and other goals of the Clean Water Act. Access to streams and rivers with adequate base flows and sufficient variability will support high quality recreational use. Information provided by canoe clubs and other river recreational interests cite changing demographics and the rise of sea kayaking as reasons for a high interest in flatwater paddling and multiple-day canoe trips.

The Licensee owns and operates several river access areas on the Connecticut River within project boundaries, and both the states of Vermont and New Hampshire manage additional sites in the vicinity of the Project. Thus, there is a clear interest in the public's ability to traverse the Connecticut River in boats and develop recreational uses. In addition to this interest the Connecticut River has been designated as America's first *"Heritage River"* and *"National Blueway."* Please see comments under Study 4(2) below concerning the National Blueway designation and its relationship to agencies.

(4) Describe existing information concerning the subject of the study proposal, and the need for additional information.

While the applicant has itemized nine camping facilities and 17 access points available on the reach from Wilder Dam to the 15-Mile Falls Dam (only a few of them provided by TransCanada), they have not provided a qualitative analysis of these facilities. These sites are managed and/or maintained by multiple parties listed by the Licensee in the PAD. Current management agencies should be surveyed by the Licensee to gather historical management and operational data, and then provide plans and upgrades to meet future recreational needs.

One of the better publications available to gather this information is *The Connecticut River Boating Guide: Source to the Sea*, published by the Connecticut River Watershed Council, 3rd Edition 2007.

In the PAD, the Licensee proposes no new camping sites or upgrades to existing facilities, nor do they propose any management plans for maintenance or enforcement.

(5) Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

This study will be the defining mechanism for identifying additional sites and improvements that can best be adapted for the increasing needs of public access and multiple-day paddling trips on the Connecticut River. Additional facilities may be required in the license.

(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

Our interest is in having sufficient information to understand what facilities exist and what, if any, improvements are necessary to manage an increasing public interest in multiple-day kayak and canoe trips on the Connecticut River. Licensee staff have the resources to complete this analysis and should include recommendations for the acquisition and development of additional facilities to meet the interests and needs identified in the multi-state SCORP documents cited by the Licensee in the PAD. This analysis can be completed during any spring, summer, or fall field season.

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

There are multiple sites along the Connecticut River that are used as access points or have camping facilities. However there are vast differences in the ability or capacity of these sites to handle paddling groups of varying size and numbers or sanitation needs. Beyond the iteration of lists provided by the Licensee in the PAD, there is no comprehensive guide or text that provides this information. Visual inspection of existing sites and facilities should take place and any needed reconstruction or rehabilitation of existing facilities should be identified.

Cost of this data collection is relatively minimal and can be completed by Licensee staff. This analysis can be completed during any spring, summer, or fall field season.

3: Economic impacts.

(1) Describe the goals and objectives of each study proposal and the information to be obtained.

The goal of the recreational economic impact study is to assess the regional economic value of facility improvements and various flow alternatives that can be provided to improve recreational opportunities at Sumner Falls and on this reach of the river in general.

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.

The requester is not a resource agency.

(3) If the requester is a not resource agency, explain any relevant public interest considerations in regard to the proposed study.

Economic stimulus is clearly in the public interest. Many New England hydropower projects support robust recreation economies. Some sections of the Deerfield (FERC No. 2334-010) are comparable, as well as the Kennebec (FERC Project No.2124), and the Magalloway and Rapid Rivers (FERC Project No. 11834-000) in Maine.

In the PAD, the Licensee cites the Massachusetts SCORP (2006-2011), which indicated a need for "water-based" activities, and one of the goals of the New Hampshire SCORP identified the need for a variety of recreational opportunities. The Vermont SCORP (2005-2009) reveals the need for access to all types of outdoor recreation.

(4) Describe existing information concerning the subject of the study proposal, and the need for additional information.

We are unaware of existing information regarding the economic potential at Wilder Dam and look forward to learning more. However, Crane Associates of Burlington, Vermont, published a study in 2005: *"The Economic Impacts of Whitewater Boating on the West River, Jamaica, Vermont."*

(5) Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

The project has restricted and diminished paddling opportunities throughout the year at Sumner Falls. Many of these days could provide predictable and scheduled kayaking, instructional paddling, and canoeing–all of which have economic values associated with any form of tourism.

Understanding the economic values that could be provided by restoring and increasing paddling recreation from Wilder Dam flows will assist FERC and other stakeholders in balancing the trade-offs associated with generational timing. In the case of the Deerfield River, the value of whitewater recreation outweighed the value of power generation by a margin of 24:1.

(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

Since the present economic values are unknown because of restricted recreational activity resulting from the construction of Wilder Dam, we request the study be compiled using the *"contingent valuation"* study method that measures individuals' *"willingness to pay."* These values can then be compared to power generation values, and extrapolated to develop an understanding of economic benefits and how those dollars will be multiplied throughout the community as benefits associated with paddling activities. Economic values contribute to the public good, and overall visitor spending will contribute to economic significance for the immediate and adjacent region.

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

Primary data should be collected through survey instruments circulated through known paddling clubs throughout New England and in the nearby Lebanon and Hanover, New Hampshire, and White River Junction, Vermont, areas during the winter months. Individual interviews should be taken on days when the nearby West River and Deerfield River are having releases, and the survey should include kayakers, canoeists, and rafters of varying abilities. Customers of commercial outfitters should also participate in the survey as well as outfitters that provide tubing equipment for those individuals that enjoy just floating down the river.

The Licensee has proposed no economic studies in the PAD.

Wilder Dam in October 2012.

4. Mitigation for Impacts of Lost Whitewater Recreation at Wilder Dam

(1) Describe the goals and objectives of each study proposal and the information to be obtained.

The goal of this study is to assess the value of whitewater boating resources eliminated by the Project and the development of on-site and off-site mitigation options that would provide adequate compensation for the loss of whitewater recreation at the Wilder Dam Project.

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.

The requester is not a resource agency.

(3) If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.

The Wilder Dam effectively eliminates the public's opportunity to enjoy a whitewater boating resource. Conducting the necessary studies and implementing the necessary measures to ensure the public has access to whitewater recreational resources is in the public interest.

Using off-site mitigation has historically been an acceptable practice in FERC licensing. This is evidenced in the Upper Androscoggin Settlement Agreement for the Rapid and Magalloway Rivers in Maine (FERC Project No. 11834-000), as well as the Canada Falls Settlement Agreement (FERC Project No. 2634) for the South Branch of the Penobscot River in Maine.

On May 24, 2012, Secretary of the Interior Ken Salazar designated the Connecticut River and Watershed as the nation's first National Blueway. A Memorandum of Understanding signed in August by the departments of Interior, Agriculture, and the Army has as one objective "providing opportunities for scientific research, environmental education and outdoor recreation and access within the National Blueway to the extent compatible with agency missions."

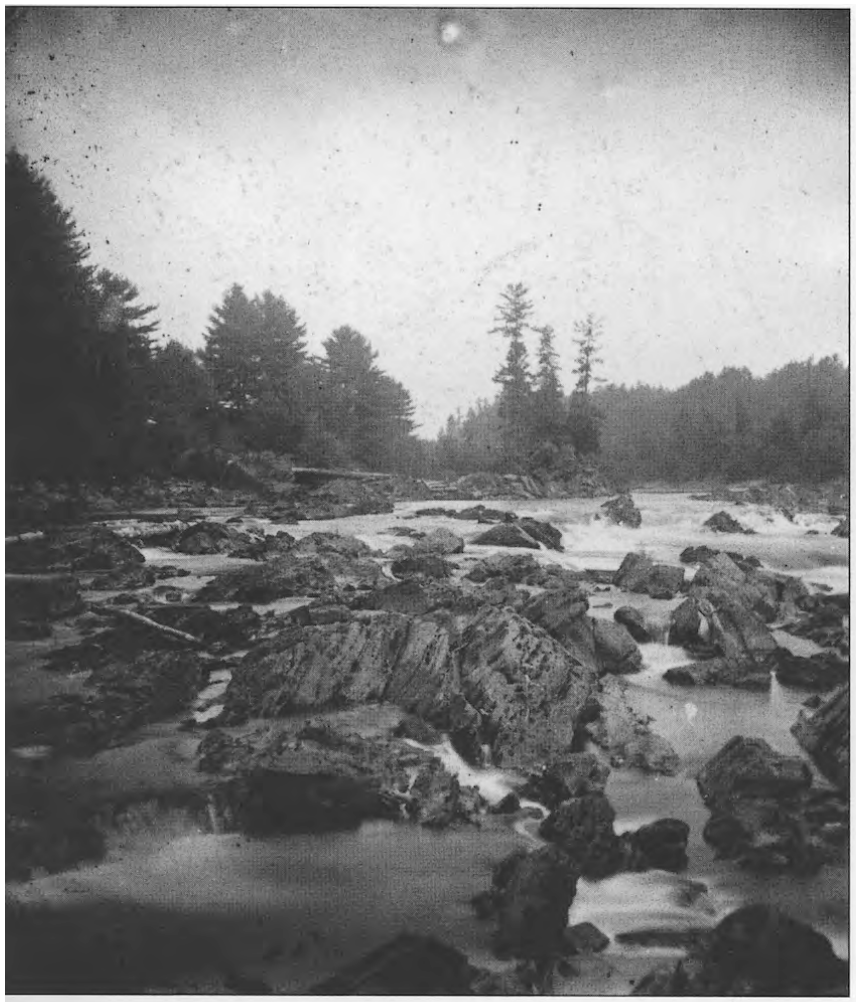
The National Blueway concept takes a watershed viewpoint and addresses the river from its source to the sea. The National Blueways System has a goal "to advance a whole river and watershed-wide approach to conservation, outdoor recreation, education, and sustainable economic opportunities in the watersheds in which we live, work, and play." The National Blueway designation includes all of the tributaries in the watershed and involves several federal agencies. These agencies include the U.S. Army Corps of Engineers, the Silvio Conte Refuge, the U.S. Fish and Wildlife Service, the National Park Service, and the States of Connecticut, Vermont, New Hampshire, and the Commonwealth of Massachusetts, which have prioritized conservation, recreation, and restoration in the 7.2 million-acre Connecticut River Watershed.

Restoration of recreation opportunities in the watershed of the Connecticut River has the potential to offer the region significant economic benefits.

(4) Describe existing information concerning the subject of the study proposal, and need for additional information.

According to the book by Frank J. Barrett, Jr., *Images of America: Hartford* (Portsmouth, N.H.: Arcadia Publishing, 2009), the Wilder Dam site was originally known as Olcott Falls and White River Falls. "Explorers of the Connecticut River valley encountered a series of three falls over a distance of about a mile as the river runs," Barrett wrote. Wilder Dam was placed atop the lower falls, thus drowning all three rapids. The total drop of the river over the two upstream falls, according to Barrett, was 37 feet (p. 108). Barrett's book provides two photos of the rapids dating from 1859 and 1882.

Current and historic project operations at the Wilder Dam provide no consistent or meaningful information for this type of mitigation. It should be determined what flows in the region are best suited for maximum recreational use.



Olcott Falls Middle Falls 1882 (Barrett, *Hartford*, p. 109)

(5) Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

The Project controls the entire flow in the Connecticut River with the exception of releasing the required minimum flow or when generating. The result damages regionally needed summer paddling opportunities on the main stem. FERC needs to balance the paddling resource and power generation under the "*Electric Consumers Protection Act*" (*16 U.S. C. §797,803*). The project nexus is direct.

Study results would and should develop the basis of license terms, including possible off-site mitigation, that could protect the public interest and provide the balance mandated under ECPA.

***(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge*.**

Analyses would include gathering information to assess the presence and quality of rivers that could be candidates for off-site mitigation. The process steps are generally 1) collaboratively identify candidate rivers and issues with the paddling community, 2) resource agency identification and feasibility assessment, 3) inter-agency meetings with resource agencies, Licensee, and representatives of the boating community with experience with assessing the feasibility of proposed measures.

We will provide volunteers and technical support for the studies as appropriate. We hope to work collaboratively with the Licensee and other agencies on this study.

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

We are willing to work with the Licensee on an on-site and off-site mitigation study to keep costs reasonable and the quality of information high. We believe that potential mitigation options can be easily and affordably identified through collaborative discussions. What will be subsequently needed is the integration of this information and organized meetings to study the feasibility of alternatives, and subsequently a written report.

Given the collaborative approach sought by the paddling community, including in-kind contributions of time and expertise, the Licensee and agencies should be able to complete these studies for this unique approach to mitigation for a very reasonable cost.

The Licensee PAD proposes no whitewater recreation mitigation analysis, either on-site or off-site.

Conclusion:

We respectively request the hydrological, recreational, and economic studies that will support the dialog and analysis regarding the flows and associated recreational values from the Wilder Dam project.

These studies should address the projected needs and interests for the term of a 30-50 year FERC license.

In addition, in these comments we offer our comments on the PAD to better inform this relicensing process. Thank you for considering these comments.

Respectfully submitted this 28th day of February, 2013

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_/s/ Norman Sims________________________
Norman Sims
Representing the Appalachian Mountain Club
16 Linden Ave.
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/s/ Kenneth Kimball______________________

Kenneth Kimball
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P.O. Box 298
Gorham, NH 03581

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

TransCanada Hydro Northeast, Inc.	Wilder Hydroelectric Project FERC No. 1892-026

CERTIFICATE OF SERVICE

Pursuant to Rule 2010 of the Commission's Rules of Practice and Procedure, I hereby certify that I have this day caused the foregoing NEW ENGLAND FLOW, AMERICAN WHITEWATER, AND THE APPALACHIAN MOUNTAIN CLUB'S COMMENTS AND STUDY REQUESTS IN RESPONSE TO THE NOTICE OF INTENT TO FILE LICENSE APPLICATION, FILING OF PRE-APPLICATION DOCUMENT (PAD), COMMENCEMENT OF PRE-FILING PROCESS, AND SCOPING: REQUEST FOR COMMENTS ON THE PAD AND SCOPING DOCUMENT, AND INDENTIFICATION OF ISSUES AND ASSOCIATED STUDY REQUESTS REGARDING THE WILDER HYDROELECTRIC PROJECT, FERC PROJECT NO. 1892-026 to be served upon each person designated on the official service list compiled by the Secretary in this proceeding.

Dated this 28th day of February, 2013.

Megan Hooker
American Whitewater
Bend, Oregon

Document Content(s)

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

TransCanada Hydro Northeast, Inc.	Bellows Falls Project FERC No. 1855-045

NEW ENGLAND FLOW, AMERICAN WHITEWATER AND THE APPALACHIAN MOUNTAIN CLUB'S COMMENTS AND STUDY REQUESTS IN RESPONSE TO THE NOTICE OF INTENT TO FILE LICENSE APPLICATION, FILING OF PRE-APPLICATION DOCUMENT (PAD), COMMENCEMENT OF PRE-FILING PROCESS, AND SCOPING: REQUEST FOR COMMENTS ON THE PAD AND SCOPING DOCUMENT, AND INDENTIFICATION OF ISSUES AND ASSOCIATED STUDY REQUESTS REGARDING THE BELLOWS FALLS HYDROELECTRIC PROJECT, FERC PROJECT NO. 1855-045.

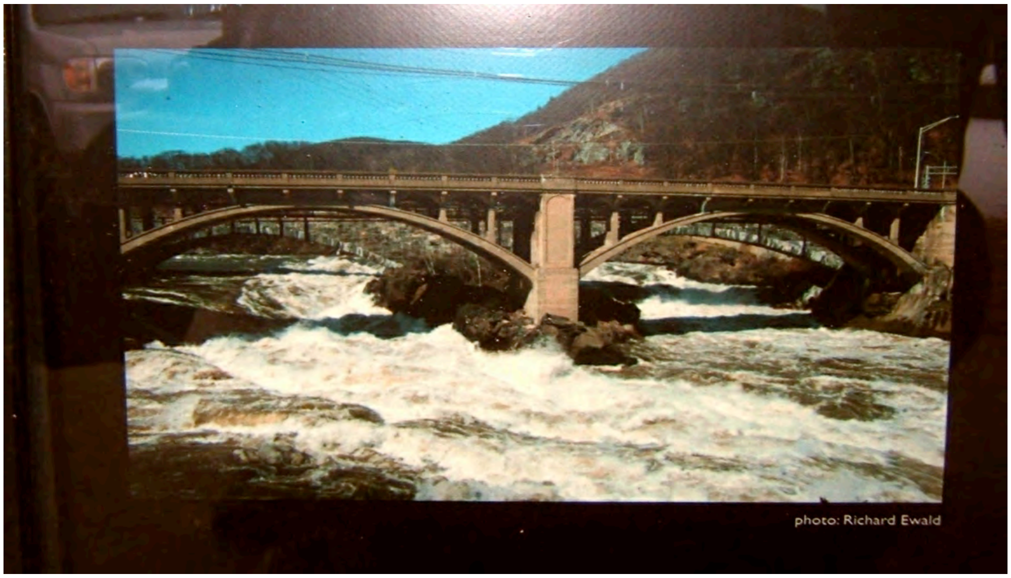
New England FLOW is a regional non-profit organization whose affiliations have represented whitewater boaters, canoeists, rafters, and other river users on multiple project re-licensings throughout New England for over 25 years. American Whitewater is a national non-profit organization dedicated to protecting and restoring our nation's whitewater resources and enhancing opportunities to enjoy them safely. Since 1876, the Appalachian Mountain Club (AMC) has promoted the protection, enjoyment, and understanding of the mountains, forests, waters, and trails of the Appalachian region and is the largest conservation and recreation organization in the Northeast with more than 90,000 members. All three organizations are "steering committee" members of the Hydropower Reform Coalition based in Washington, D. C. Our members, who are primarily conservation-oriented kayakers, canoeists, and rafters living in this area of the Northeast, would enjoy this section of the Connecticut River as a weekend trip.

The Bellows Falls bypassed reach, the original riverbed of the Connecticut River, has the ability to offer paddling opportunities of sufficient quality through spill events. This site would be a very good location to develop a whitewater park, and at moderate flows the run could be used by canoeists and kayakers for surfing waves and for acrobatic tricks called "freestyle" paddling. All manufacturers of whitewater kayaks design boats for this purpose.

The recreational use of the resources at this project has the potential to add significant economic value to the region given its central location and its proximity to Dartmouth College, Norwich University, and the communities of Bellows Falls, Springfield, and White River Jct., Vermont, as well as Lebanon, New Hampshire. Millions of people live within a three-hour drive.

Issue #1: Impacts of the Connecticut River flow diversion and project works on recreational paddling at the Bellows Falls bypass reach.

The Bellows Falls project de-waters a 0.7-mile reach of the Connecticut River that has no flows except for some leakage. Any natural boatable flows are provided during spill events, and are generally inaccessible, high, flashy, and unpredictable. The current operation of the project virtually eliminates any valuable paddling opportunities.



Bellows Falls Bypass Reach Before Dam Construction

In addition to the elimination of all flows through the bypass reach except for leakage, the licensee has constructed a dangerous low-head weir that further prevents boaters from using this reach during high flow spillage events.

Low-head Weir

The Bellows Falls Dam itself, the reservoir, the low-head weir in the reach, and the downstream impoundment, in concert with the elimination of flows severely impacts whitewater rapids and recreation.

A subset of the paddling opportunities eliminated by the project could be restored with moderate, stable, and predictable flows of sufficient volume to support whitewater recreation between late spring and early fall months. With this said, the cumulative effects of the project works and downstream impoundment render this highly impacted reach of questionable recreational value in its current state.

To mitigate for continued diversion of significant flow, and for the recreational impacts of the diversion dam and other project works, a whitewater feature or series of features (e.g., waves or rapids) could be constructed that optimize freestyle paddling opportunities at a prescribed range of flows. This could be done in concert with removal or modification of the low-head dam in a manner that meets both recreational and fish barrier goals, and eliminates an objective hazard. The Bellows Falls diversion reach, if suitable flows were provided, appears to be an ideal location for this form of mitigation. There may be other sites as well on the Connecticut River or in the watershed.

Furthermore, the construction of features, access, and the provision of flows in the Bellow's Falls diversion reach or elsewhere could serve as mitigation for comparable and even more severe impacts at the Wilder and Vernon projects.

In the PAD the Licensee proposes no flow enhancement, weir removal, or whitewater feature construction to mitigate the project's effects on whitewater recreational use.

In addition to recreation and aesthetics, we recognize that flow-related decisions also affect economic factors related to power generation, fish passage, and other environmental variables. We look forward to exploring how all flow-related values relate to one another through participation in this relicensing process.

Issue # 2: Public Access for whitewater boating, rafting, and canoeing is inadequate.

Directly below the Bellows Falls Dam, there is currently no formal public access or parking for whitewater boaters or canoeists. In order to put in for access to the whitewater rapids in the bypass reach, boaters would need to descend a steep slope studded with large boulders from a heavily traveled roadway. However, there are many examples of licensees developing successful access points regardless of steep grades to reach riverbeds, including at the Kennebec River (FERC Project No. P-23229-ME) in Maine.

The run ends at the confluence of the bypass reach with the main stem Connecticut River below the powerhouse. The access road along the east side of the river is New Hampshire Route 12. Vermont Route 5 is an additional access road on the west side of the river, however there is a railroad between the road and the river. The steep riverbanks make egress at the end of the run difficult, and boaters would have to paddle a considerable stretch of flatwater to a portage take-out downstream.

In the PAD the Licensee proposes no new river access areas.

Issue # 3: Camping and sanitary facilities available for multiple-day kayaking or canoe trips.

In the PAD, the Licensee cites the Massachusetts SCORP (2006-2011), which indicated a need for "water-based" activities, and one of the goals of the New Hampshire SCORP identified the need for a variety of recreational opportunities. The Vermont SCORP (2005-2009) reveals the need for access to all types of outdoor recreation. While the applicant has itemized and described the different recreational and access points available throughout the reach from the Bellows Falls Dam to the Wilder Dam, they have not provided a qualitative analysis of these facilities.

Information provided by canoe clubs and other river recreational interests cite changing demographics and increasing use of sea kayaks to explain the high interest in flatwater paddling and multiple day canoe trips.

The applicant has itemized three camping facilities and 11 access points (not all of which are maintained by TransCanada) in the reach from the Bellows Falls Dam to the Wilder Dam; however they have not provided a qualitative analysis of these facilities. These sites are managed and/or maintained by multiple parties, and at a minimum there should be consistent standards for sanitation, safety, and control of litter or camping debris.

Issue #4: Economic Impacts.

The diversion of flow around the Bellows Falls Dam has significant negative recreational impacts and related socio-economic impacts. By changing the operational scenario of the Bellows Falls Project and constructing a whitewater park, (See Appendix) the potential exists to create new tourism products for a region that is primed to capitalize on it. Retail activity, and food and lodging opportunities will be geared toward non-commercial paddlers, and thousands of people who currently travel to the region each year for rafting, kayaking and other outdoor adventure activities will discover added value to the region.

In making a public interest decision, FERC must weigh the value of water in the power canal against the value of water in the natural riverbed, and then reach a comprehensive plan for the development of the river that strikes the appropriate balance and is best adapted to the river. In many dam relicensing proceedings the values of flow restoration are largely recreational and ecological, and thus hard to evaluate in dollars. In this case, because of the significant economic potential of a whitewater park to increase recreation with increased flows, we believe FERC should also weigh the predicted economic values associated with the recreational use when looking at various alternatives.

Issue #5: Alternatives for off-site mitigation.

Bellows Falls Dam sits atop a whitewater falls, after which it is named, and its reservoir drowns other whitewater drops as the river approaches the dam. Alternatives in the form of off-site mitigation could create compensatory whitewater opportunities.

Like FERC, we prefer on-site mitigation focused on the impacted river. However, given the cumulative effect of the Bellows Falls and other Connecticut River projects on whitewater recreation, onsite mitigation may be infeasible or may not be the most cost effective alternative.

There may be mitigation opportunities elsewhere on the Connecticut River or in the Connecticut River watershed. Mitigation could come in the form of improved access, flows, or features. This concept follows the guidelines for the newly-established National Blueways System, in which the Connecticut River and Watershed has been named the first National Blueway.

Study Requests

We hereby request several studies per 18 CFR 5.9(b).

1. Whitewater Park Feasibility Study.

(1) Describe the goals and objectives of each study proposal and the information to be obtained.

The goal of the whitewater park study is to assess the potential for mitigation in the form of the construction of one or more whitewater features, access to and viewing of those features, and the provision of suitable flows.

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.

The requester is not a resource agency.

(3) If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.

The Bellows Falls bypass reach offers the public an opportunity to enjoy a high quality whitewater boating resource with the development of a whitewater park. Conducting the necessary studies and implementing the necessary measures to ensure the public has access to high quality outdoor recreational resources is in the public interest. It is widely accepted that outdoor recreation has significant benefits to participants including health, well being, and quality-of-life. Outdoor recreation also has proven economic benefits for communities located near recreational resources.

Whitewater parks offer adults and youth alike an outstanding and low risk means of getting exercise outdoors and building river-running and free-style paddling skills. They often serve as a recreational centerpiece for communities in providing opportunities for both direct participation as well as viewing.

Restoration of recreation opportunities in the Connecticut River has the potential to offer the region significant economic benefits.

***(4) Describe existing information concerning the subject of the study proposal, and need for additional information*.**

In cases where on-site restoration of lost paddling opportunities proved impossible, Licensees have supported the planning and/or construction of whitewater parks as mitigation. The most noteable example is the Holtwood Hydroelectric Project on the Susquehanna River (P-1881). At the Holtwood project, the Licensee is constructing two whitewater features and public access, and providing flows to optimize the whitewater features.

Whitewater Park, Denver

Whitewater Park Columbus, Georgia. (Photo: McLaughlin Whitewater Design Group)

The Bellows Falls bypassed channel has suitable gradient, constriction, and rock structure for a high quality whitewater park. The town setting is typical of the most successful parks. Further analysis by an expert would be required to scope the specific potential of the site.

(5) Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

The Project controls the entire flow in the Connecticut River with the exception of releasing the "*required minimum flow of 1,083 cfs or inflow, whichever is less*" into the main stem river or when generating. The bypass reach has no minimum flow, but there is leakage into the natural riverbed. The result is the virtual elimination of valuable and regionally needed summer paddling opportunities in the bypass reach. The project works directly eliminate whitewater features and create objective and artificial hazards. The Connecticut River can be a high-quality paddling resource, and since paddling is a flow-dependent activity, the project directly affects paddling on the Connecticut River. The project nexus is direct.

Results of this study may produce evidence supporting mitigating license requirements for a whitewater park and scheduled releases in the bypass reach. It should be noted the development of whitewater parks as mitigation have been part of previous FERC relicensing agreements, most notably on the Lower Chattahoochee River in Georgia and the Susquehanna River in Pennsylvania.

Bellows Falls bypass reach 2012

***(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge*.**

We request a feasibility study for the construction and management of a whitewater park. These studies are routine and relatively standard. The McLaughlin Whitewater Design Group and Recreational Engineering and Planning are two firms that conduct such studies. As experienced engineers, designers and hydrologists, they have worked extensively with municipalities, public utilities, the U.S. Army Corps of Engineers, and paddling groups throughout the United States. You can see examples of studies they have conducted here:

http://www.boaterparks.com/studies.html, and under the "portfolio" tab here: http://mclaughlinwhitewater.com

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

The Licensee PAD proposes no whitewater park feasibility analysis. This no-action step will reveal nothing about project impacts on whitewater recreation or opportunities for protection, mitigation, or enhancement measures. A feasibility study should not be prohibitively expensive.

2. Public Access Study (Recreation Use and Needs).

(1) Describe the goals and objectives of each study proposal and the information to be obtained.

The goal of this study is to identify and define adequate access points that provide trails and parking, at the beginning and end of the bypass reach.

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;

The requester is not a resource agency,

(3) If the requester is a not resource agency, explain any relevant public interest considerations in regard to the proposed study.

The public has an interest in healthy rivers and streams that fully support the full suite of beneficial uses and other goals of the Clean Water Act. Access to streams and rivers with adequate base flows and sufficient variability to support high quality whitewater recreational use will support other businesses within the regional economy.

The Bellows Falls bypass reach offers the public an opportunity to enjoy a high quality whitewater boating resource with the development of a whitewater park. Conducting the necessary studies and implementing the necessary measures to ensure the public has access to high-quality outdoor recreational resources is in the public interest. It is widely accepted that outdoor recreation has significant benefits to participants including health, well being, and quality-of-life. Outdoor recreation also has proven economic benefits for communities located near recreational resources.

Restoring recreation opportunities in the Connecticut River has the potential to offer the region significant economic values and coincides with the goals of the National Blueway designation for the Connecticut River and Watershed.

(4) Describe existing information concerning the subject of the study proposal, and the need for additional information.

There is an inconsistent body of knowledge regarding access needs in this reach, and we look forward to learning more. The PAD does not identify access points for any type of whitewater use.

(5) Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

The project eliminates or does not provide access points for whitewater use. The studies we request are vital to developing a mechanism for defining access points that can best be adapted for a whitewater park. Access would be necessary if a whitewater park were used as a mitigating license requirement.

Access stairway at Kennebec River in Maine

Shown above is an example of the type of access that was required as part of the Harris Dam relicensing on the Kennebec River (FERC Project P-23229-ME). Similar construction would provide adequate access to the Bellows Falls bypass reach.

(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including

appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

The flows that paddlers enjoy on virtually every undammed stream are natural components of the flow regime that provide recreation and other multiple functions. Hydropower project operations often disrupt, and in this case have eliminated, access that would otherwise naturally provide these recreational values. We request sufficient analysis be conducted to understand the Project topography that would detail which sites would best provide adequate access and egress for a whitewater park. Use of Geographic Information System (GIS) may provide a general overview of potential access points within Project bounds and may be helpful.

However, given the steep topography leading to the bypass reach, this work should be completed using accepted and certified surveying methods that "ground truth" any GIS analysis. Scheduling this work should be completed during the summer field season when low seasonal flow will allow surveying activities within the bypass reach.

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

The recommended GIS analysis is a relatively simple desktop analysis using software that is currently available and thus should require little effort or cost. Once potential access points are identified, the cost of surveying is nominal when presented in the context of other studies required by FERC or other stakeholders. No other studies would address the specificity required to identify, layout and design adequate access for this project.

3: Camping and sanitary facilities available for multiple-day kayaking or canoe trips (Recreation Use and Needs).

(1) Describe the goals and objectives of each study proposal and the information to be obtained.

The goal of this study is to provide a quantitative and qualitative analysis of existing facilities to determine their capacity to manage the increasing number of paddlers who are making multiple-day trips on the Connecticut River. It should examine the adequacy of such facilities over the 30-50 year life of the license. This study can also identify other points on the river that would be suitable for the establishment of additional facilities if the Licensee were required to purchase the properties.

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;

The requester is not a resource agency.

(3) If the requester is a not resource agency, explain any relevant public interest considerations in regard to the proposed study.

In the PAD, the Licensee cites the Massachusetts SCORP (2006-2011), which indicated a need for "water-based" activities, and one of the goals of the New Hampshire SCORP identified the need for a variety of recreational opportunities. The Vermont SCORP (2005-2009) reveals the need for access to all types of outdoor recreation.

Several agencies have management goals that are associated with the creation of the National Blueway System (NBS) and with the Connecticut River and Watershed, which is the first National Blueway. (See study request #5 below.) In particular, the U.S. Department of the Interior has pioneered in creating the NBS.

The public has an interest in healthy rivers and streams that fully support the full suite of beneficial uses and other goals of the Clean Water Act. Access to streams and rivers with adequate base flows and sufficient variability will support high-quality recreational use. Information provided by canoe clubs and other river recreational interests cite changing demographics and a switch to sea kayaking as reasons for the high interest in flatwater paddling and multiple day canoe trips. The main obstacles to multiple-day canoe trips on the Connecticut River are the hydropower dams themselves. The applicant should be required in the license to provide adequate camping, access, and portage facilities to accommodate paddlers who want to spend more than a few hours on the river at a time.

(4) Describe existing information concerning the subject of the study proposal, and the need for additional information.

In the PAD, the Licensee identifies 11 sites within Project boundaries as access points to the Connecticut River, such as boat ramps or car-top access. However, none of these sites are designated for camping, nor do they have sanitary facilities. One of the better publications available to gather this information is *The Connecticut River Boating Guide: Source to the Sea*, published by the Connecticut River Watershed Council, 3rd Edition 2007. The requested study should supplement and update that information and provide a basis for license requirements.

(5) Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

This study will be the defining mechanism for identifying additional sites that can best be adapted for increasing public access and multiple-day paddling trips on the Connecticut River. The Licensee may be required to purchase additional land to accommodate the public, or to upgrade facilities to a national standard that includes toilets, trash removal, and safe put-in and take out opportunities. The study should also evaluate and make recommendations for replacing the horrible portage around the Bellows Falls Dam.

(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

Our interest is in having sufficient information to understand what facilities exist and what, if any, improvements are necessary to manage the increasing multiple-day kayak and canoe trips on the Connecticut River. This analysis should include recommendations for the acquisition and development of additional facilities to meet the interest and needs identified in the multi-state SCORP documents cited by the Licensee in the PAD, and that are adequate for a 30-50 year license.

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

There are multiple sites along the Connecticut River that are used as access points or have camping facilities. However, there are vast differences in the ability or capacity of these sites to handle paddling groups of varying size and numbers or sanitation needs. Because there is no comprehensive guide or text that provides updated information, visual inspection of existing sites should take place. Any needed reconstruction or rehabilitation of existing facilities should be identified.

This analysis can be completed during any spring, summer, or fall field season. Such field research needs to be matched with projections of use in the future and with standard requirements for access sites, campsites, and sanitation facilities.

4: Economic analysis.

(1) Describe the goals and objectives of each study proposal and the information to be obtained.

The goal of the recreational economic analysis is to establish the economic values so they can be compared to the value of power generation, along with the economic benefits of various restoration alternatives that can be provided by restoring flows to the Bellows Falls bypass reach.

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.

The requester is not a resource agency.

(3) If the requester is a not resource agency, explain any relevant public interest considerations in regard to the proposed study.

Economic stimulus is clearly in the public interest. Many examples of whitewater parks support robust recreation economies, including those that have been constructed in Charles City, Elkader, and Iowa City, Iowa, as well as South Bend, Indiana; Springfield, Ohio; Yorkville, Illinois; and Petoskey, Michigan.

The federal agencies that are associated with the National Blueways System (NBS), including the Department of the Interior, the National Park Service, and the U. S. Army Corps of Engineers are all concerned with the health and well-being of resources in the Connecticut River watershed.

(4) Describe existing information concerning the subject of the study proposal, and the need for additional information.

We are unaware of existing information regarding the economic potential of the Bellows Falls bypass reach and look forward to learning more. However, Crane Associates of Burlington, Vermont, published a study in 2005; *"The Economic Impacts of Whitewater Boating on the West River, Jamaica, Vermont."* The West River is in the Connecticut River Watershed and is included in the NBS.

(5) Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

The project has eliminated all paddling opportunities on the Bellows Falls bypass reach throughout the year except during flood stage. Many of these days could provide kayaking, instructional paddling, rafting, and canoeing, all of which have ancillary economic benefits associated with any form of tourism.

Understanding the economic values that could be provided by restoring paddling recreation to the Bellows Falls bypass reach will assist FERC and other stakeholders in balancing the trade-offs associated with lost generation. In the case of the Deerfield River the value of whitewater recreation outweighed the value of power generation by a margin of 24:1.

(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

Since the present economic values are either unknown or zero because there is currently no recreational activity in the bypass reach, we request the study be compiled using the *"contingent valuation"* method that measures individuals' *"willingness to pay."* These values can then be compared to the dollar values of power generation. Economic benefits can be extrapolated to develop an understanding of how those dollars will be multiplied throughout the community as benefits associated with paddling activities. Overall visitor spending will contribute to economic significance for the immediate and adjacent region. Contingent valuation is a standard methodology used in resource economics. Such a study can be done at Bellows Falls when conditions are appropriate, such as during test runs.

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

Primary data should be collected through survey instruments circulated through known paddling clubs throughout New England during the winter months. Individual interviews should be taken on days when the nearby West River and Deerfield River are having releases, and the survey should include kayakers, canoeists, and rafters of varying abilities. Customers of commercial outfitters should also participate in the survey, as well as outfitters that provide tubing equipment for those individuals who enjoy just floating down the river.

5. Mitigation for Impacts on the Connecticut River and Loss of Whitewater Recreation below Bellows Falls Dam

(1) Describe the goals and objectives of each study proposal and the information to be obtained.

The goal of this study is to assess the value of whitewater boating resources eliminated by the Project and the development of a suite of on-site and off-site mitigation options that would provide adequate compensation for the loss of whitewater recreation at the Bellows Falls Project.

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.

The requester is not a resource agency.

(3) If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.

The Bellows Falls Project effectively eliminates the public's opportunity to enjoy a whitewater boating resource. Conducting the necessary studies and implementing the necessary measures to ensure the public has access to whitewater recreational resources is in the public interest.

We have proposed a whitewater park feasibility study that will highlight on-site and potentially off-site mitigation options. Additional off-site mitigation options may exist nearby in the Connecticut River watershed that could include the construction of a whitewater park, enhanced flow regimes, improved river access, riparian conservation, or other opportunities.

Using off-site mitigation has historically been an acceptable practice in FERC licensing. This is evidenced in the Upper Androscoggin Settlement Agreement for the Rapid and Magalloway Rivers in Maine (FERC No. 11834-000), as well as the Canada Falls Settlement Agreement (FERC No. 2634) for the South Branch of the Penobscot River in Maine.

On May 24, 2012, Secretary of the Interior Ken Salazar designated the Connecticut River and Watershed as the nation's first National Blueway. A Memorandum of Understanding signed in August by the Departments of Interior, Agriculture, and the Army has an objective of "providing opportunities for scientific research, environmental education and outdoor recreation and access within the National Blueway to the extent compatible with agency missions." The National Blueway concept takes a watershed viewpoint and addresses the river from its source to the sea. The National Blueways System has as its goal "to advance a whole river and watershed-wide approach to conservation, outdoor recreation, education, and sustainable economic opportunities in the watersheds in which we live, work, and play." The National Blueway designation includes all the tributaries in the watershed and involves several federal agencies. These agencies include the U.S. Army Corps of Engineers, the Silvio Conte Refuge, the U.S. Fish and Wildlife Service, the National Park Service, and the States of Connecticut, Vermont, New Hampshire, and the Commonwealth of Massachusetts, which have prioritized conservation, recreation, and restoration in the 7.2 million-acre Connecticut River Watershed.

Restoration of recreation opportunities in the watershed of the Connecticut River has the potential to offer the region significant economic benefits.

(4) Describe existing information concerning the subject of the study proposal, and need for additional information.

Current and historic project operations at the Bellows Falls Dam provide no consistent or meaningful information for this type of mitigation. Much more is known about regional flow, access, and conservation needs. We look forward to collaboratively exploring these opportunities with the Licensee and other stakeholders.

(5) Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

The Project controls the entire flow in the Connecticut River. The Bellows Falls bypass reach has no minimum flow requirement. The result damages regionally needed summer paddling opportunities on the main stem. The dam itself was built on the Bellows Falls, and the reservoir drowned upstream rapids, which would be sufficient cause for off-site mitigation. The fish barrier bisects and destroys the recreational value of the reach by posing an objective hazard and altering the biggest rapid. FERC needs to balance the paddling resource and power generation under the *"Electric Consumers Protection Act" (16 U.S. C. §797,803*). The project nexus is direct.

Study results would and should develop the basis of license terms, including possible off-site mitigation, that could protect the public interest and provide the balance mandated under ECPA.

(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

We have described one component of this study in a separate request for a whitewater park feasibility study. Additional analyses would include gathering information to assess the presence and quality of rivers that could be candidates for off-site mitigation. The process steps are generally 1) collaboratively identify candidate rivers and issues with the paddling community, 2) resource agency identification and feasibility assessment, and 3) inter-agency meetings with resource agencies, Licensee, and representatives of the boating community with experience with assessing existing needs of candidate rivers to determine feasibility of proposed measures.

We will work with the licensee to document the known information regarding candidate rivers. We will provide volunteers and technical support for the studies as appropriate. We hope to work collaboratively with the licensee and other agencies on this study.

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

We are willing to work with the Licensee on an on-site and off-site mitigation study to keep costs reasonable and the quality of information high. We believe that potential mitigation options can be easily and affordably identified through collaborative discussions. What will be subsequently needed is the integration of this information and organized meetings to study the feasibility of alternatives, and subsequently a written report.

Given the collaborative approach sought by the paddling community, including in-kind contributions of time and expertise, the Licensee and agencies should be able to complete these studies for a very reasonable cost.

The Licensee PAD proposes no whitewater recreation mitigation analysis, either on-site or off-site.

Conclusion:

We respectively request whitewater park feasibility, river access, camping, economic, and off-site mitigation studies that will support the dialog and analysis regarding the restoration and mitigation of recreational values associated with the Bellows Fall project. All such studies should take into consideration a projection of the public's need for water-based recreation for the 30-50 year life of the proposed license.

In addition, in these comments we offer our comments on the PAD, to better inform this relicensing process. Thank you for considering these comments.

Respectfully submitted this 28th day of February, 2013

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APPENDIX

"Chattahoochee River Restoration Market Economic Impact Analysis"

Chattahoochee River Restoration Columbus, Georgia and Phenix City, Alabama

Market and Economic Impact Analysis

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Chattahoochee River Restoration
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Executive Summary

The Chattahoochee River has served as a focal point of development of the downtown areas of Columbus, GA and Phenix City, AL. The Riverwalk, Trade Center and corresponding development of the downtown area of Columbus and the Amphitheater, Riverwalk and community development projects in Phenix City have created a focus for continuing efforts to enhance the downtown areas of both cities and create an economic center.

The "Chattahoochee River Restoration Columbus, GA and Phenix City, AL" project will provide additional economic benefits to the community. The project is expected to add to the community's recreational base and thus to the overall quality of life in the community. The additional business activity and resulting support for employment created by the recreational use of the river will provide for further growth of existing business as well as creating opportunities for new business enterprise.

From an economic development perspective, the restoration project's inclusion of a whitewater venue is an important feature. Based on industry surveys, whitewater activities such as kayaking and rafting have experienced significant increases in levels of participation. Over one-third of the participants in kayaking and rafting activities live in the south. While there are a number of natural whitewater opportunities within reasonable driving distance, the closest urban whitewater venue is over 200 miles away from the proposed site. The venue would also be closer for participants in Atlanta, GA and Birmingham, AL than any of the existing sites.

It is estimated that the whitewater venue will attract between 60,000 to 100,000 patrons annually. The total direct economic impact of the whitewater venue is estimated to be between $4,202,584 and $7,004,306 on an annual basis. By the nature of an economic system, direct spending is then multiplied through the economy and creates indirect economic impact. The economic multiplier for tourism spending at the local level is approximately 1.7. As a result the total economic impact (direct plus indirect) is estimated to be between $7,144,392 and $11,907,321 on an annual basis. The project is also expected to support between 154 and 257 jobs in the community.

This project is expected to positively impact real estate values in the downtown areas adjacent to the development. It is estimated that over the period from 2005 to 2011 that property values in Columbus, GA will increase by 61% and values in Phenix City, AL will increase by 37%.

I. Introduction

The Chattahoochee River has served as a focal point of development of the downtown areas of Columbus, GA and Phenix City, AL. The Riverwalk, Trade Center and corresponding development of the downtown area of Columbus and the Amphitheater, Riverwalk and community development projects in Phenix City have created a focus for continuing efforts to enhance the downtown areas of both cities and create an economic center.

The proposed project presented in the "**Chattahoochee River Restoration Columbus, Georgia and Phenix City, Alabama"** (2005) will create an opportunity for further development of the waterfront regions of the downtown areas and provide additional economic impact for the development of new and existing businesses in the affected areas. With the completion of the restoration project, the community (on both sides of the river) will have available a new tourism attraction and an enhancement to the recreational inventory for its residents. Further enhancements to the Riverwalk will add to the base of riverfront development that has helped to revitalize the downtown area.

As proposed the "River Restoration Project" includes:

- Restore the riverine conditions within the 2.3 mile reach of the Chattahoochee River impounded by the Eagle and Phenix Dam and the City Mills Dam.
- Create conditions conducive for the expansion of biological community's characteristic of Fall Line riverine shoal habitat and the free passage of fish within the areas presently impounded by the Eagle and Phenix Dam and the City Mills Dam.
- Maximize the recreation potential of the Chattahoochee River following elimination of the impoundments created by the Eagle and Phenix Dam and City Mills Dam.
- Further enhancement to the Riverwalk to include a pedestrian bridge across the Chattahoochee River linking Columbus, GA and Phenix City, AL and their respective riverfront developments.

The River Restoration Project would create the opportunity to develop recreational use of the river and provide business opportunities and revenue generating activities. Enhancements to the Riverwalk would provide additional benefits to current community activities (festivals) and create new opportunities for community events and tourism generating projects.

The U.S. Army Corp of Engineers has published numerous reports on the environmental impact of river restoration projects. The estimated environmental benefits from a river restoration project, flowing to society as a whole, is estimated to be quite large and, by itself, might justify any such project. However, recognizing the decision making process is more localized and looks to the benefits generated to the communities involved in the project, it is the economic impact that attracts the most attention.

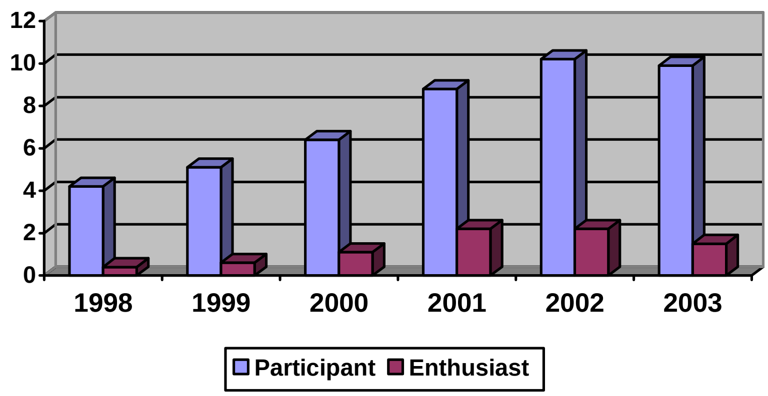
This report focuses on the economic impact of the project. The economic impact of the River Restoration Project has been analyzed in terms of traditional measures of such impact, tourism dollars and job creation, as well as projections of the real estate impact of further development of the riverfront region of the community. In an effort to fully explain the projected impact of the project this report provides a market analysis of whitewater recreation.

II. Whitewater Recreation

Outdoor activity, as measured by the Outdoor Industry Association's 2004 Participant Survey, has shown a significant increase over the period from 1998 to 2003. In 2003, nearly two-thirds of Americans 16 and older participated in at least one of the core human powered activities. Participant levels were up 8% from 1998 when 59.9 million were identified as a Participant. Commitment to human powered activities as measured by Enthusiast levels are also up since 1998. One in five (19.5% or 42.9 million) Americans 16 and older participated in at least one of the core outdoor activities in 2003 at Enthusiast levels. Comparatively, overall Enthusiast activity was reported in 1998 as 16.2% (or 34.1 million) Americans 16 and older. Participant level is defined as having at least one experience during the year, for example one kayaking trip. A person is classified as an enthusiast if they participate in a sport three or more times in a year.

The two core human powered activities most closely aligned with whitewater activities are kayaking and rafting. The Outdoor Industry Association's Participant survey shows that participation in kayaking has grown significantly since 1998 with the number of Participants and Enthusiast doubling over the period. This dramatic increase is shown in Chart 1. The survey estimates that 5.2% of the United States population age 16 and over participated in kayaking activities in 2003.

Chart 1
Participation in Kayaking
(millions)



According to the Outdoor Industry Association, the geographical profile of kayaking participants reveals that there exists a rather even distribution across the nation. Table 1 shows the national distribution of kayaking participants as well as a breakdown by kayaking formats.

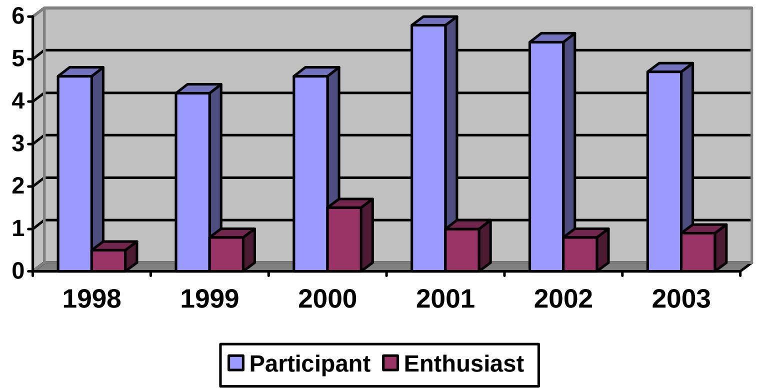
Table 1
Regional Kayaking Distribution

Format	Northeast	South	North Central	West
Participants	27%	27%	20%	26%
- Recreation Kayaking	27%	27%	21%	26%
- Touring Kayaking	29%	22%	18%	32%
- Whitewater Kayaking	23%	35%	26%	16%
Enthusiasts	30%	22%	13%	35%

It is interesting to note that over one-third of the “whitewater kayakers” in the United States reside in the South.

The Outdoor Industry Association’s 2004 Participants survey showed a modest growth in sport of rafting. Approximately 10.3 million of the American population (4.7%) age 16 and older was classified as rafting participants in 2003. Another 2 million Americans over the age of 16 were classified as enthusiasts. Chart 2 shows the trend in rafting participation over the period from 1998 to 2003.

Chart 2
Participation in Rafting
(millions)



The geographical profile of those participating in rafting is somewhat similar to the distribution for kayaking. The profile is shown in Table 2.

Table 2
Regional Rafting Distribution

Level of Rafting	Northeast	South	North Central	West
Participant	21%	35%	22%	22%
Enthusiast	30%	24%	15%	31%

As with kayaking, over one-third of those cited as participants live in the south.

The popularity of whitewater recreation has grown significantly in the United States over the last two decades. The impact of the development of whitewater venues has been the focus of numerous studies. Traditionally speaking, whitewater venues are usually thought of in association with mountains and their natural river resources. However, more recent development efforts have involved development in more urban regions.

Data compiled from the American Whitewater Association shows that there are 532 river related whitewater venues in operation. A complete listing of these whitewater river venues is provided in Appendix I. The venues are rated by class from Class I to Class VI. The international rating system for rivers and rapids, provided by the American Whitewater Association, is as follows:

Class I: **Easy.** Fast moving water with riffles and small waves. Few obstructions, all obvious and easily missed with little training. risk to swimmers is slight; self-rescue is easy.

Class II: **Novice.** Straightforward rapids with wide, clear channels which are evident without scouting. Occasional maneuvering may be required, but rocks and medium sized waves are easily missed by trained paddlers. Swimmers are seldom injured and group assistance, while helpful, is seldom needed. Rapids that are at the upper end of this difficulty range are designated "Class II+".

Class III: **Intermediate.** Rapids with moderate, irregular waves which may be difficult to avoid and which can swamp an open canoe. Complex maneuvers in fast current and good boat control in tight passages or around ledges are often required; large waves or strainers may be present but are easily avoided. Strong eddies and powerful current effects can be found, particularly on large-volume rivers. scouting is advisable for inexperienced parties. Injuries while swimming are rare; self-rescue is usually easy but group assistance may be required to avoid long swims. Rapids that are at the lower or upper end of this difficulty range are designated "Class III-" or "Class III+" respectively.

Class IV: **Advanced.** Intense, powerful but predictable rapids requiring precise boat handling in turbulent water. Depending on the character of the river, it may feature large, unavoidable waves and holes or constricted passages demanding fast maneuvers under pressure. A fast, reliable eddy turn may be needed to initiate maneuvers, scout rapids, or rest. Rapids may require moves above dangerous hazards. Scouting may be necessary the first time down. Risk of injury to swimmers is moderate to high, and water conditions may make self-rescue difficult. Group assistance for rescue is often essential but requires practiced skills. A strong Eskimo roll is highly recommended. Rapids that are at the upper end of this difficulty range are designated "Class IV-" or "Class IV+" respectively.

Class V: **Expert.** Extremely long, obstructed, or very violent rapids which expose a paddler to added risk. Drops may contain large, unavoidable waves and holes or steep, congested chutes with complex, demanding routes. Rapids may continue for long distances between pools, demanding a high level of fitness. What eddies exist may be small, turbulent, or difficult to reach. At the high end of the scale, several of these factors may be combined. Scouting is recommended but may be difficult. Swims are dangerous, and rescue is often difficult even for experts. A very reliable Eskimo roll, proper equipment, extensive experience, and practiced rescue skills are essential. Because of the large range of difficulty that exists beyond class IV, class V is an open ended, multiple level scale designated by class 5.0, 5.1, 5.2, etc... Each of these levels is an order of magnitude more difficult than the last. Example: increasing difficulty from class 5.0 to class 5.1 is a similar order of magnitude as increasing from class iv to class 5.0.

Class VI: **Extreme and exploratory.** These runs have almost never been attempted and often exemplify the extremes of difficulty, unpredictability and danger. The consequences of errors are very severe and rescue may be impossible. For teams of experts only, at favorable water levels, after close personal inspection and taking all precautions. After a class VI rapids has been run many times the rating may be changed to an appropriate class 5.x rating.

The “Class breakdown” of the venues shown in Appendix I is detailed in Table 3. In this analysis venues were assigned to the Class that was maintained the most when operational.

Table 3
United States Whitewater River Classification
May 2005

Class	Number
I	19
II	186
III	154
IV	95
V	78
VI	0

The most recent development in whitewater recreation is the creation of artificial whitewater parks. These “man-made” whitewater venues have generally been located in more urban areas and have brought the “whitewater experience” to the consumer. The vast majority of these venues are located in the western part of the country, many strategically located near the Rocky Mountains. There are only eight existing or proposed such venues east of the Mississippi River. Most of these eastern sites are located in the northern tier of states. Southern sites include the Ducktown, TN operation near the Upper Ocoee River, the National Whitewater Center in Charlotte, NC (currently under construction) and the proposed operation on the Chattahoochee River in Columbus, GA. Table 4 details a listing of some of the “whitewater parks” that are either currently in operation or are in some stage of development.

Table 4
(Source: Paddler Magazine May/June 2005)

Completed Whitewater Parks			
#	**Venue Name**	**Locale**	**Completion Date**
1	Truckee River	Reno, Nevada	2003
2	Payette River	Horseshoe Bend, Idaho	1995
3	The Green	Green River, Wyoming	
4	North Platte River	Casper, Wyoming	2002
5	Weber River	Ogden, Utah	2002
6	Arkansas River	Buena Vista, Colorado	

7	Arkansas River	Salida, Colorado	1987
8	Fall River	Estes Park, Colorado	2003
9	Gore Creek	Vail, Colorado	2002
10	Clear Creek	Golden, Colorado	1998
11	Yampa River	Steamboat Springs, Colorado	
12	Boulder Creek	Boulder, Colorado	1990
13	South Platte River/Cherry Creek	Denver, Colorado	1974
14	St. Vrain River	Pueblo, Colorado	1990
15	Arkansas River	Pueblo, Colorado	
16	San Juan River	Pagosa Springs, Colorado	
17	Animas river	Santa Fe, New Mexico	1995
18	Animas River	Farmington, New Mexico	2000
19	Trinity River	Fort Worth, Texas	2003
20	East Race Waterway	South Bend, Indiana	1984
21	Wisconsin River	Wausau, Wisconsin	1984
22	Upper Ocoee River	Ducktown, Tennessee	1996
23	Potomac River	Dickerson, Maryland	1992
Projects in the Works			
24	Bear River	Evanston, Wyoming	*Planned*
25	Blue River	Siverthorne, Colorado	*Planned*
26	Gunnison River	Gunnison, Colorado	*Planned*
27	Colorado River	Grand Junction, Colorado	*Planned*
28	American River	Auburn, California	*Planned*
29	Adventure Sports Center International	McHenry, Missouri	*Planned*
30	National Whitewater Center	Charlotte, North Carolina	*Planned*
31	Chattahoochee River	Columbus, Georgia	*Planned*
32	Mississippi River	Minneapolis, Minnesota	*Planned*

The market for urban based whitewater operations has developed quickly and has resulted in the organization of the First Annual Whitewater Park Conference scheduled for October 2005. This conference is co-sponsored by the Professional Paddlers Association, a key organization in the whitewater community.

III. Impact Analysis

The economic impact of developing a whitewater park is two-fold. The first portion of the impact is in the form of benefits to the local community. A whitewater park adds to the inventory of recreational activities available in the community. Like the addition of other parks or recreational facilities, the overall quality of life is improved as the base of activities is expanded. Likewise, many studies have shown that improvements to the overall quality of life in a community provide additional benefits to the community's efforts to market itself to new businesses looking for places to locate.

A second benefit of a whitewater park is the development of the tourism industry. Such parks draw their users from the community at-large and from whitewater enthusiasts. Whitewater parks are available for both individual use by tourists, but can also be marketed for event style activities. Competitive whitewater events, like other events such as softball or soccer tournaments or even a convention, bring supporters to the host community. The direct result of the whitewater venue is that they bring more people into the community who in turn will use the services and facilities of existing businesses. As many tourism studies have shown, the infusion of tourism dollars can be significant and provide impetus to a community's efforts to stimulate economic activity.

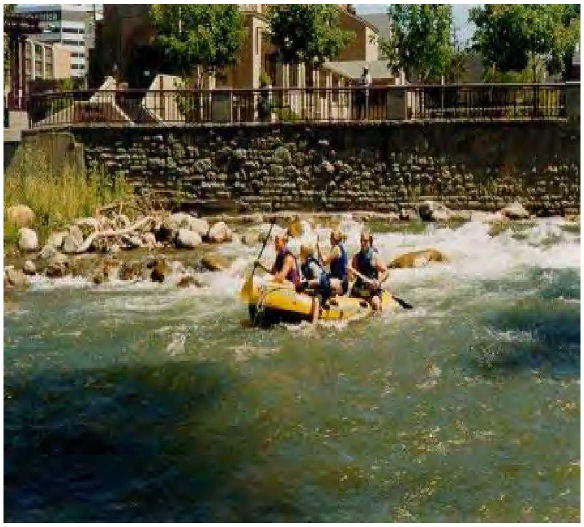
The development of whitewater parks around the country has led to the economic impact studies of the parks. Private sector, university-based, and governmental units have analyzed the economic impact of river restoration and whitewater park development on communities across the nation.

An excellent summary of some of these studies was done by Charles Sims of the Department of Forestry, Wildlife, and Fisheries at the University of Tennessee – Knoxville. In this 2002 study, Mr. Sims reviewed a series of studies performed on the economic impact of whitewater boating activity published in the 1990's. While there was similarity in the results of the reviewed studies, Mr. Sims correctly identified that the studies tended to underestimate the full economic impact of the whitewater recreation of the subject communities.

In the Sims study, impact estimates ranged from a low of $490,500 to a high of $14 million. The wide range of estimates is the result of the variance in the periods of operations. Many of the whitewater venues are only operation for short periods due to weather and/or water flows.

Like the studies reviewed by Sims, other studies conclude that the operation of a whitewater venue provides millions of dollars of economic impact to the host communities. The revenues generated by river use and utilization of business services in the host communities (hotels/motels, food establishments, and other retail outlets) are multiplied through the local economic systems. As a result the whitewater venue, like other tourism style attractions, provides the community with additional business activity.

Another excellent analysis of the impact of a whitewater venue was done in conjunction with the Truckee River Whitewater Park in Reno, NV. The Whitewater Park in Reno (pictures at left) runs through the business district of the city and is part of the city's overall economic development plan. Impact estimates for this facility are $2-4 million dollars per year.

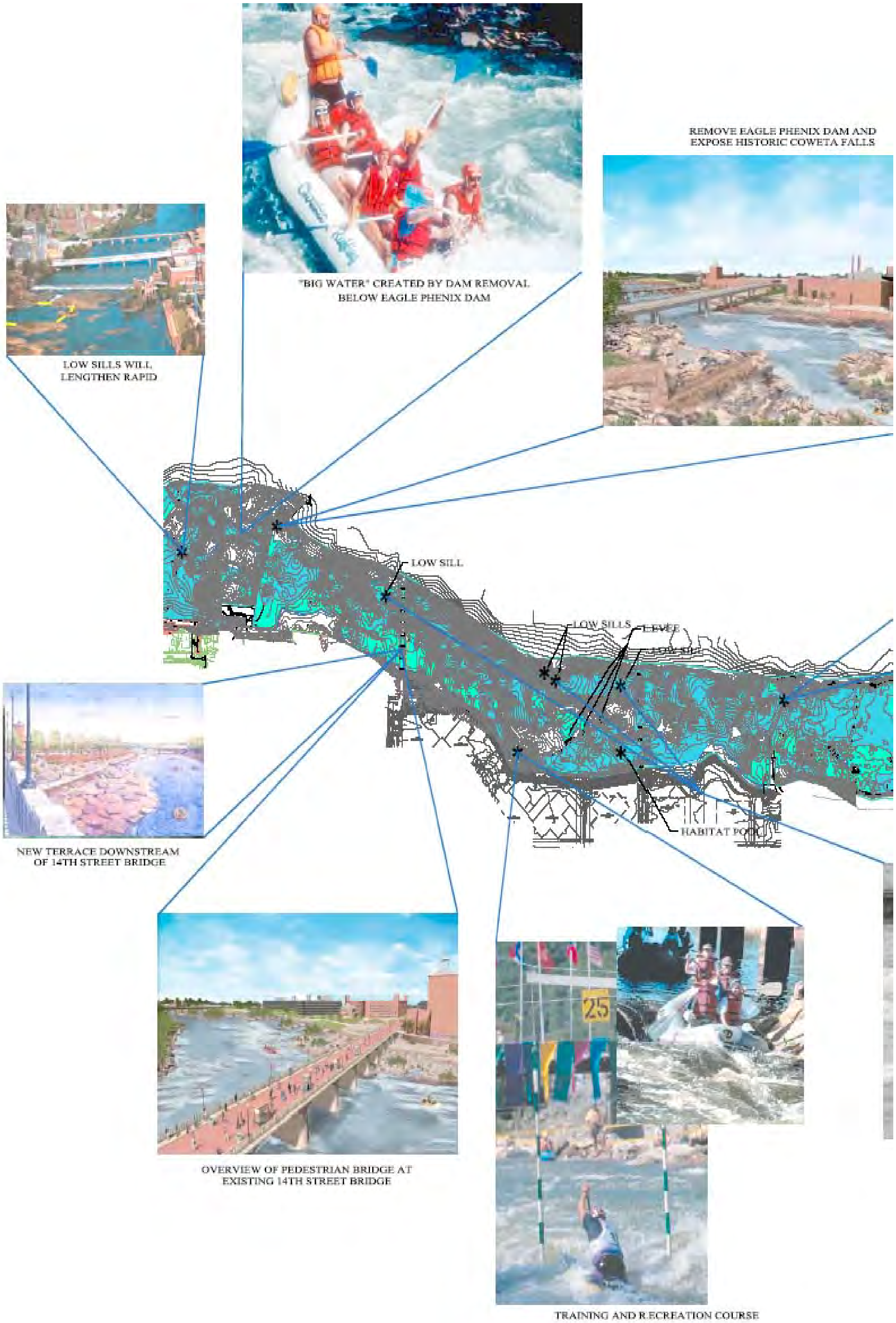


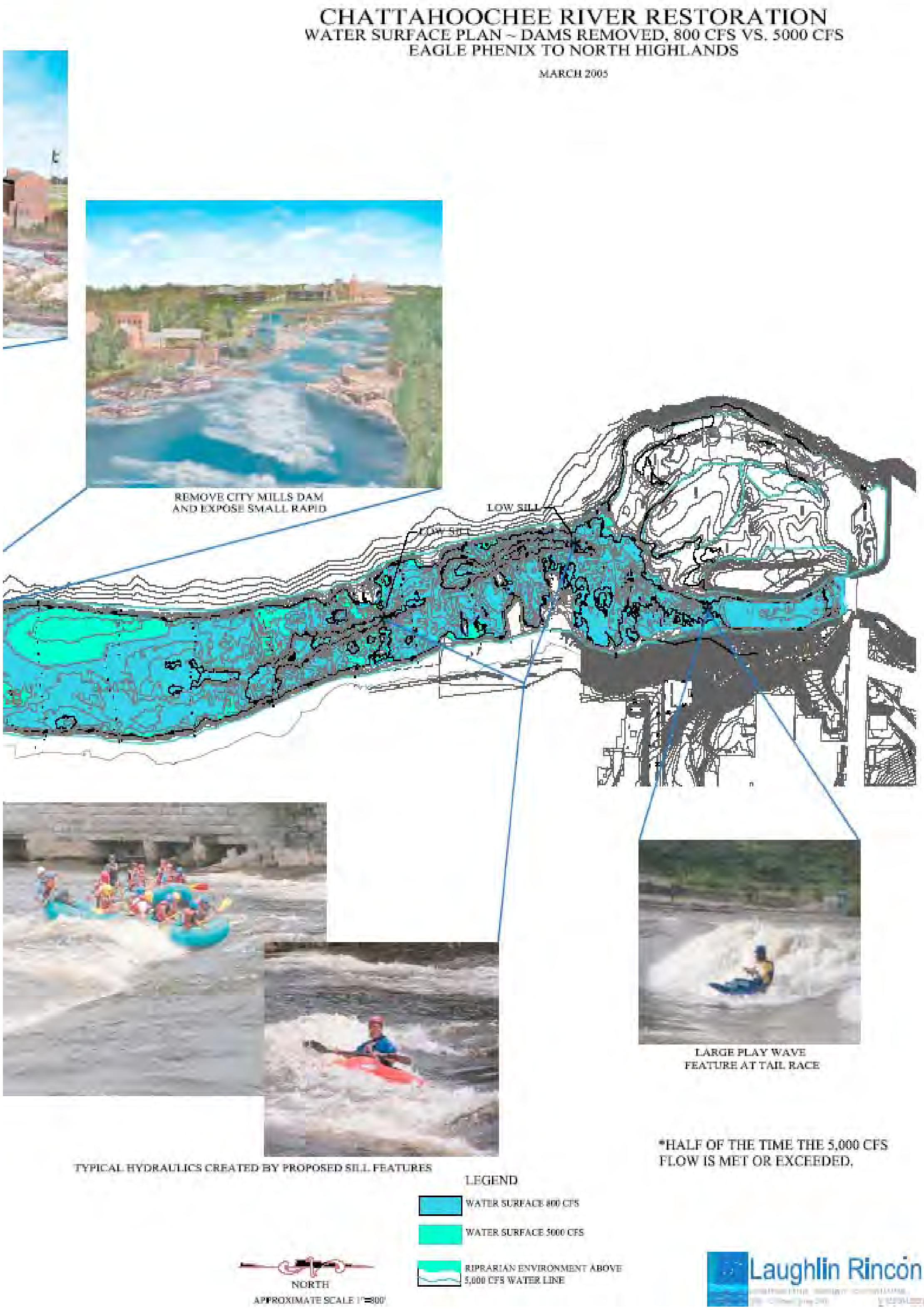
The Whitewater Park opened in November of 2003. The operation of the Truckee River Whitewater Park provides for use by all levels of participants and due to consistent water flows, the facility is operational for much of the year. The facility was designed for both recreational use and competitive events. The Whitewater Park allows for use by rafters and kayak/canoes. The park is tied to other riverfront developments such as the city's river walk.

The boldest of the economic impact studies performed on a whitewater venue is the analysis performed in the U.S. National Whitewater Center in Charlotte, NC. The most recent estimate of this venue's total annual economic impact is $36.7 million. This seemingly high estimate is the result of the nature of the venue relative to other whitewater parks. The Charlotte park is a totally enclosed structure with limited and controlled access. The impact analysis is predicated on the park's ability to generate over $9 million in fees and offers multiple recreation opportunities beyond just water sports.

IV. The Chattahoochee River Restoration Project

The proposed restoration of the Chattahoochee River in the downtown areas of Columbus, GA and Phenix City, AL will create an opportunity to develop a whitewater venue in the heart of the business district and add to the inventory of recreational activities of the


"BIG WATER" CREATED BY DAM REMOVAL
BELOW EAGLE PHENIX DAM
REMOVE EAGLE PHENIX DAM AND
EXPOSE HISTORIC COWETA FALLS
LOW SILLS WILL
LENGTHEN RAPID
LOW SILL
LOW SILLS
LEVEE
NEW TERRACE DOWNSTREAM
OF 14TH STREET BRIDGE
OVERVIEW OF PEDESTRIAN BRIDGE AT
EXISTING 14TH STREET BRIDGE
25
TRAINING AND RECREATION COURSE


CHATTAHOOCHEE RIVER RESTORATION
WATER SURFACE PLAN ~ DAMS REMOVED, 800 CFS VS. 5000 CFS
EAGLE PHENIX TO NORTH HIGHLANDS
MARCH 2005
REMOVE CITY MILLS DAM
AND EXPOSE SMALL RAPID
LOW SILL
LOW SILL
LARGE PLAY WAVE
FEATURE AT TAIL RACE
TYPICAL HYDRAULICS CREATED BY PROPOSED SILL FEATURES
*HALF OF THE TIME THE 5,000 CFS
FLOW IS MET OR EXCEEDED.
LEGEND
WATER SURFACE 800 CFS
WATER SURFACE 5000 CFS
RIPRARIAN ENVIRONMENT ABOVE
5,000 CFS WATER LINE
NORTH
APPROXIMATE SCALE 1"=800'
Laughlin Rincon

community. In addition, the whitewater venue would provide additional resources to the further development of the tourism industry in the area. The nature basis of such a venue ties in well with other tourism activities of the region that include Callaway Gardens, and Providence Canyon. A graphic detail of the project is included on the preceding pages.

The “River Restoration Project” includes the restoration of riverine conditions on the Chattahoochee River, the reestablishment of the river’s biological habitat and community, maximizing the recreational use of the Chattahoochee River along the project, and enhancing both Columbus and Phenix City’s riverfront development strategic plans. The starting point for the project entails the restoration of the riverine conditions within the 2.3 mile reach of the Chattahoochee River impounded by the Eagle and Phenix Dam and the City Mills Dam. The structures are cracking and starting major deterioration. The initial uses of the dams facilitated business operations and electrical power generation but now without businesses to utilize the dams’ generated power, eliminating them will restore the river to its original swiftwater habitat.

The restoration project will create conditions conducive for the expansion of biological community’s characteristic of Fall Line riverine shoal habitat and the free passage of fish within the areas presently impounded by the Eagle and Phenix Dam and the City Mills Dam. The removal of the Eagle and Phenix Dam and the City Mills dam will once again assist in the restoration of the natural habitat of various species of aquatic life along the Fall Line. Since over the years the multiple dams reduced approximately 97% of the Chattahoochee’s natural flow, the river habitat’s reduction lowered the number of shoal bass and fresh water mussels and other species unique to the area. The removal of the dams will increase the sport fishing activity for swiftwater conditions. Since the river drops approximately 35 feet over the course of this project, restoring the river’s natural flow reestablishes additional historical and recreational opportunities for the west central Georgia and east Alabama communities.

In order to maximize the recreation potential of the Chattahoochee River, the elimination of the impoundments created by the Eagle and Phenix Dam and City Mills Dam will restore the natural swiftwater flow to the river. With the closest whitewater and kayaking venues hundreds of miles away, the restoration project will provide the Columbus/Phenix City metropolitan area a reliable fast water source for these activities. With whitewater rafting and boating one of the fastest growing sports in the U.S., the growth in these activities provide unique opportunities to the market. As discussed earlier, other increases in recreational use such as increased swiftwater fishing, kayaking and competitive water tournaments will all add to the increased river access created by the project.

The restoration project also includes further enhancement to the Riverwalk includes a pedestrian bridge across the Chattahoochee River linking Columbus, GA and Phenix City, AL. This pedestrian bridge will link the two cities and their respective riverfront developments. Both governments of Columbus and Phenix City are fully behind the cooperative efforts of the Chattahoochee River Governance Subcommittee, Uptown Columbus and the East Alabama Riverfront Development (EARD) entities. The pedestrian bridge will strengthen these entities' efforts by further safely connecting pedestrian traffic between the two cities. Connection of the two development areas will provide ease of access for residents and visitors of each side of the river to cross and add to the economic well being of both locales. The pedestrian bridge will also serve as a great location for viewing any competitive whitewater events. It will assist the two cities in providing opportunities for joint festivals, celebrations, and ventures promoting the two cities.

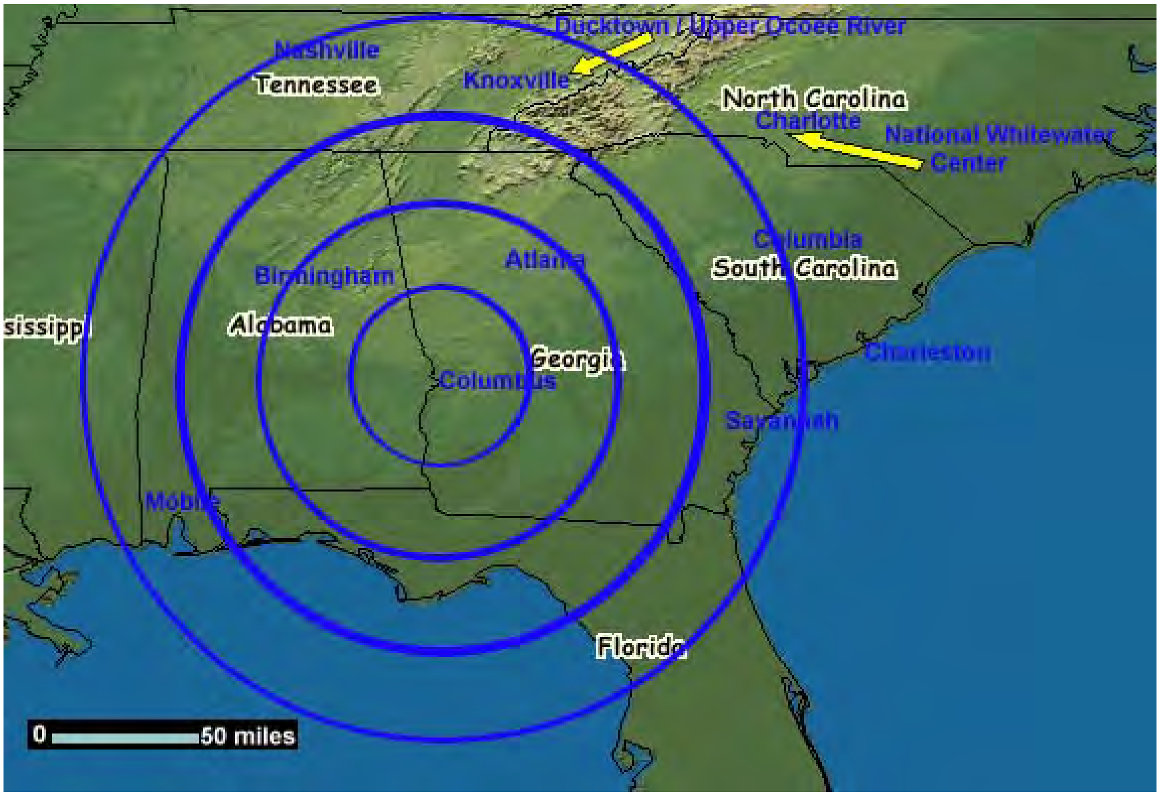
V. Economic Impact of the Chattahoochee Restoration Project

In analyzing the economic impact of the restoration project it was assumed that the full project would be completed. As such, after the dams were removed, the whitewater venue would be created and operational. The recreational development is expected to meet national and international competitive standards for whitewater venues. The analysis dealt with two different aspects of the economic impact. The first aspect was the economic impact resulting from the whitewater venue. The second portion of the analysis focused on the real estate impact of these developments along the river.

A. Whitewater Impact

A whitewater venue on the Chattahoochee River located in the business districts of Columbus, GA and Phenix City, AL would provide an economic benefit to the community's economic system. Due to geographical location of the proposed development, the whitewater venue would be operational on a year-round basis and serve as draw to kayakers and rafters who are currently going to other facilities. There are other whitewater operations in the mountains of north Georgia, eastern Tennessee, and the western part of the Carolinas. However, the closest urban based whitewater facilities are the operations in Charlotte (under construction) and in Ducktown, TN. Map 1 illustrates the openness of the whitewater market in the southern region that the proposed Chattahoochee River project faces.

Map 1
Southeast Region



The proposed venue would draw whitewater participants and enthusiasts from a number of large urban markets such as Atlanta, GA and Birmingham, AL. Due to the geographical location of the venue and the expectation that it will meet competitive standards, the whitewater venue could be used as a host site for major regional and/or national competitions.

The creation of a whitewater venue in Columbus, GA / Phenix City, AL would also enhance the community's efforts to attract convention business and other events such as softball and soccer tournaments. The "whitewater experience" would be an added attraction to the community and serve as a marketing tool for convention and visitors planners.

After a review of impact studies done on other whitewater venues and projected and actual utilization statistics of similar facilities, projections were made for the number of patrons that would be expected to use the proposed whitewater venue on the Chattahoochee River. The patron market was viewed as a two-segment market based on the assumption that the project would draw both competitive whitewater enthusiasts and casual whitewater participants. For the purposes of estimating the dollars of economic impact that would be anticipated from the project, it was assumed that:

- The whitewater operation would be open year-round and outfitters would be licensed to provide both rafting and kayaking opportunities.
- The community would host two competitive events each year.
- The whitewater venue would be utilized during existing community events (such as the annual "Thunder on the Hooch" event).

Utilizing these assumptions, usage figures were established. Based on other such operations it is estimated that the local venue would be able to attract between 60,000 to 100,000 participants per year. Table 5 details the breakdown of participants by source.

Table 5
Chattahoochee River Whitewater Utilization

Participant Level	Market		Source	
	Local	Out-of-town	Events	Regular Use
60,000	33,000	27,000	6,000	54,000
100,000	55,000	45,000	10,000	90,000

"Event patrons" include competitive events and festivals and represent both those actually using the river and patrons viewing the event.

Using information from the Georgia Department of Tourism, the out-of-town patrons of the whitewater project were identified as either persons who would be staying overnight or classified as single-day visitors. The overnight visitors are also divided between those who would utilize local hotel and motels and persons staying with family/friends in the area. Therefore, in total, the out-of-town patrons are expected to be dispersed into three categories. This distribution is shown in Table 6.

Table 6
Distribution of Out-of-town Whitewater Visitors

Participant Level	Out-of-Town	Staying in Local Facilities	Staying with family/friends	Day Visitors
60,000	27,000	15,390	5,400	6,210
100,000	45,000	25,650	9,000	10,350

Expenditures estimates provide by the Georgia Department of Tourism show that visitors who stay over night in a local establishment spend approximately $110 per day per person. For the other classes of visitors, those staying with family/friends and day visitors, the average daily expenditure is $65 per person. The direct economic impact of the whitewater venue was estimated utilizing these average daily expenditures. The results of this analysis, detailed by category of spending are shown in Table 7 and Table 8.

Table 7
Direct Economic Impact of Whitewater Visitors
(Usage level = 60,000)

Expenditure Category	Staying in Local Facilities	Staying with family/friends	Day Visitors
Accommodations	$584,051	$0	$0
Food/Drink	$454,262	$106,224	$61,079
Entertainment	$194,684	$63,734	$36,647
Retail	$389,367	$127,468	$73,294
Transportation	$194,684	$63,734	$36,647
Miscellaneous	$129,789	$42,489	$24,431
Total Spending	$1,946,835	$403,650	$232,099

Table 8
Direct Economic Impact of Whitewater Visitors
(Usage level = 100,000)

Expenditure Category	Staying in Local Facilities	Staying with family/friends	Day Visitors
Accommodations	$973,418	$0	$0
Food/Drink	$757,103	$177,039	$101,798
Entertainment	$324,473	$106,224	$61,079
Retail	$648,945	$212,447	$122,157
Transportation	$324,473	$106,224	$61,079
Miscellaneous	$216,315	$70,816	$40,719
Total Spending	$3,244,725	$672,750	$386,831

Usage fees represent an additional amount of spending to be added to the above sums. It is estimated that the whitewater operation will result in approximately $1,620,000 in usage fees for 60,000 participants and $2,700,000 for 100,000 participants. Therefore the total direct economic impact of the whitewater venue is estimated to be $4,202,584 on an annual basis for 60,000 participants and $7,004,306 for 100,000 participants.

By the nature of an economic system, direct spending is then multiplied through the economy and creates indirect economic impact. The economic multiplier for tourism spending at the local level is approximately 1.7. As a result the total economic impact (direct plus indirect) is estimated to be $7,144,392 on an annual basis at the 60,000 participant level and $11,907,321 for 100,000 participants.

The economic impact of the whitewater venue will translate into additional employment opportunities in the local economy. Based on the expenditure patterns detailed in Table 7 and the total impact estimate the whitewater venue is expected to support 154 jobs in the community with a patron level of 60,000 and 257 with 100,000 patrons. The distribution of these employment positions is shown in Table 9.

Table 9
Jobs Supported by the Whitewater Venue

Employment Category	Number of Jobs (60,000 participants)	Number of Jobs (100,000 participants)
Accommodations	22	37
Food/Drink	21	35
Entertainment	12	20
Retail	20	33
Transportation	7	11
Miscellaneous	7	11
Whitewater Operations	66	110
Total	154	257

B. Real Estate Impact

A real estate market analysis was performed to estimate the impact of further development and utilization of the river in the downtown Columbus, GA and Phenix City, AL on property values in the affected area. Prior developments along the both sides of the river provide an excellent basis for anticipating the impact of future projects.

Prior to and in the period following the 1996 Summer Olympic Games significant investments were made to improve and develop use of the riverfront. The Riverwalk was created, parks developed and an Amphitheater was built to focus activity towards the river. The result was an increase in amounts of traffic and economic activity in and around the downtown area closely aligned with the river.

A survey of property values in Columbus and Phenix City in the areas adjacent to the riverfront improvements was conducted. The analysis looked at property values in the area over the period from 1990 to 2004. The area surveyed included:

- For Columbus, GA: properties in the area from Bay Ave east to First Ave from 8th Street to 13th Street.

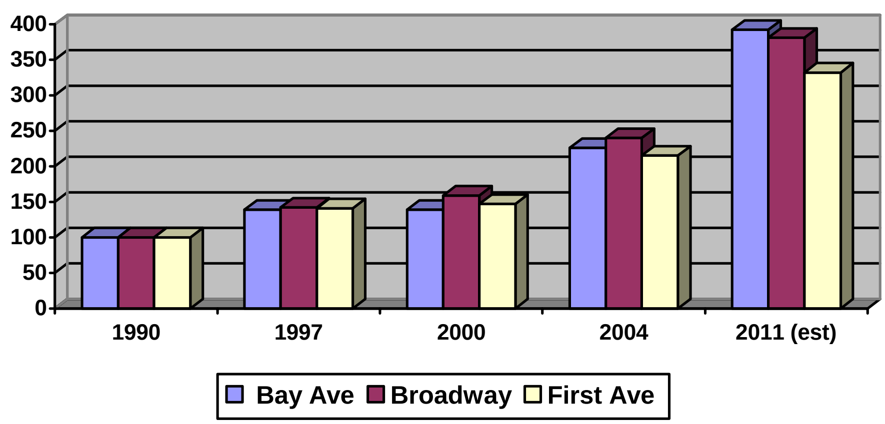
- For Phenix City, AL: properties in the area from Broad Ave and Third Ave from 8th to 15th Street.

The basis of the model was to identify the trend in property values over the period. Prior to this analysis it was hypothesized that in the period from 1990 to 1997 that property values would have increased at a somewhat rapid pace. It was further expected that in the period after 1997 that the rate of increase would slow from the earlier experience.

As expected, the value of property in and around the area affected by the improvement to the riverfront experienced rapid increases in the period from 1990 to 1997. Likewise, in the period from 1997 to 2000 these rates of increase slowed significantly. However, the data also show another period of rapid increases in value in the 2000 to 2004 period.

To demonstrate the results of the analysis property values were indexed to their 1990 value (i.e. 1990 value = 100). For subsequent years the index was adjusted based on the change in the value of the property. Charts 3 and 4 show the historical rates of change in property values in the surveyed area. From this analysis a projection of the impact of the proposed developments were made under the assumption that the project begins in the near future (2006-7) and is completed by 2011.

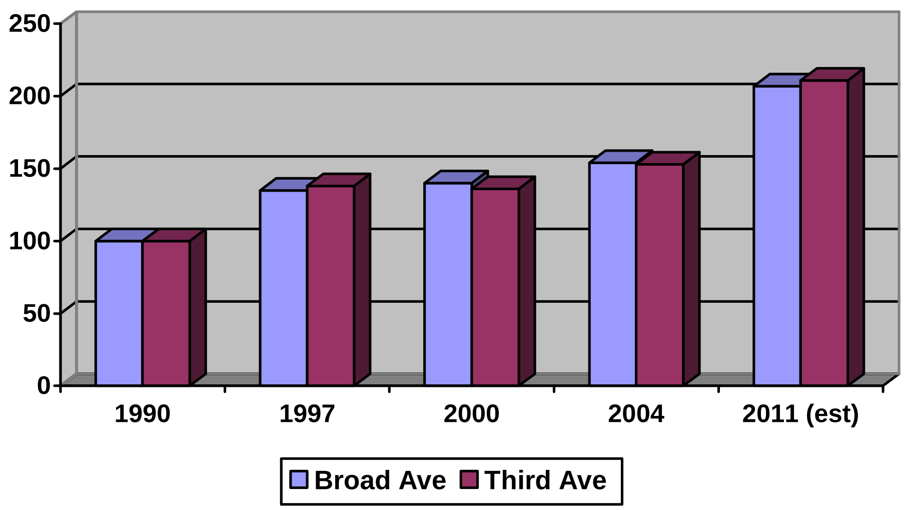
Chart 3
Property Value Analysis for Columbus, GA
(Index: 1990 = 100)



In the Columbus analysis, property value increases were initially higher along Broadway and First Ave. Values along Bay Ave. began catching up in the 2000-2004 period and are projected to match changes along Broadway and exceed those along First Ave. with the completion of the new project.

The Phenix City analysis shows somewhat similar results. However, it is expected that values for property in the area adjacent to the river development will increase in somewhat parallel fashion. Though not shown in Chart 5 due to limited available data, property values along Second and Fifth Avenues have shown increases in line with those for Broad and Third Ave in the 2000-04 time frames.

Chart 4
Property Value Analysis for Phenix City, AL
(Index: 1990 = 100)



The scope of the proposed River Restoration Project and the resulting growth of business development are on a larger scale than earlier river improvements. As a result, the total impact of this project is expected to exceed earlier experience. The proposed project covers a longer stretch of the river and will involve properties that are currently not part of the main central business districts on either side of the river. Therefore on a per property basis, the potential impact on real estate values will be slightly less than earlier experience. On a conservative side it is projected that property values will increase 61% in Columbus and 37% in Phenix City over the period from 2005 to 2011.

VI. Conclusions

The "Chattahoochee River Restoration Columbus, GA and Phenix City, AL" project will provide additional economic benefits to the community. The project is expected to add to the community's recreational base and thus to the overall quality of life in the community. The additional business activity and resulting support for employment created by the recreational use of the river will provide for further growth of existing business as well as creating opportunities for new business enterprise.

The creation of a whitewater venue as a result of river restoration places the community in a solid recreational market. It will provide these cities with the opportunity to draw visitor dollars from throughout the southern region since similar venues are relative far away. Further, the ability to operate on a year-round basis further enhances the potential increase in economic activity resulting from the whitewater venue.

Furthering the process of riverfront development will also continue the on-going revitalization of each community's downtown business districts. This process of revitalization has been proceeding for more than a decade and will gain added impetuous through this project. Additional pedestrian traffic, new events, new business, and increase value of downtown investment are all benefits expected to result from the River Restoration Project. Improvements to the existing Riverwalk areas on both sides of the river are also part of this process. Enhancements to the community's infrastructure and the strengthening of the community ties between Columbus and Phenix City are key benefits to this project.

As this analysis has shown, the overall project will allow the community to take advantage of one of its natural resources and create a viable addition to its business and recreational base. The strength of kayaking and rafting markets, as demonstrated by industry surveys and the geographical location of the community provides an ideal combination for business development. With an estimated annual impact of over $3.3 million and the creation and support for over seventy jobs, the project provides the community the opportunity to expand the local economy.

Another important element of the economic impact of this project is the resulting increases in property values in the affected area. Increasing values attract new investment and encourage current owners to maintain or improve their existing holding. As such, the downtown community should continue to improve.

Overall this project has all the elements of a sound venture. It provides for improved infrastructure and restoration of the river, expanded business activity and employment, enhanced value of property, and more closing aligning the economic development efforts of the communities involved.

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UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

TransCanada Hydro Northeast, Inc.	Bellows Falls Project FERC No. 1855-045

CERTIFICATE OF SERVICE

Pursuant to Rule 2010 of the Commission's Rules of Practice and Procedure, I hereby certify that I have this day caused the foregoing NEW ENGLAND FLOW, AMERICAN WHITEWATER AND THE APPALACHIAN MOUNTAIN CLUB'S COMMENTS AND STUDY REQUESTS IN RESPONSE TO THE NOTICE OF INTENT TO FILE LICENSE APPLICATION, FILING OF PRE-APPLICATION DOCUMENT (PAD), COMMENCEMENT OF PRE-FILING PROCESS, AND SCOPING: REQUEST FOR COMMENTS ON THE PAD AND SCOPING DOCUMENT, AND INDENTIFICATION OF ISSUES AND ASSOCIATED STUDY REQUESTS REGARDING THE BELLOWS FALLS HYDROELECTRIC PROJECT, FERC PROJECT NO. 1855-045 to be served upon each person designated on the official service list compiled by the Secretary in this proceeding.

Dated this 28th day of February, 2013.

Megan Hooker
American Whitewater
Bend, Oregon

Document Content(s)

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

TransCanada Hydro Northeast, Inc.	Vernon Hydroelectric Project FERC No. 1904-073

NEW ENGLAND FLOW, AMERICAN WHITEWATER, AND THE APPALACHIAN MOUNTAIN CLUB'S COMMENTS AND STUDY REQUESTS IN RESPONSE TO THE NOTICE OF INTENT TO FILE LICENSE APPLICATION, FILING OF PRE-APPLICATION DOCUMENT (PAD), COMMENCEMENT OF PRE-FILING PROCESS, AND SCOPING: REQUEST FOR COMMENTS ON THE PAD AND SCOPING DOCUMENT, AND INDENTIFICATION OF ISSUES AND ASSOCIATED STUDY REQUESTS REGARDING VERNON HYDROELECTRIC PROJECT, FERC PROJECT NO. 1904-073

New England FLOW is a regional non-profit organization whose affiliations have represented whitewater boaters, canoeists, rafters, and other river users on multiple project re-licensings throughout New England for over 25 years. American Whitewater is a national non-profit organization dedicated to protecting and restoring our nation's whitewater resources and enhancing opportunities to enjoy them safely. Since 1876, the Appalachian Mountain Club (AMC) has promoted the protection, enjoyment, and understanding of the mountains, forests, waters, and trails of the Appalachian region and is the largest conservation and recreation organization in the Northeast with more than 90,000 members. All three organizations are "steering committee" members of the Hydropower Reform Coalition based in Washington, D. C. Our members who are primarily conservation-oriented kayakers, canoeists, and rafters would enjoy this section of the Connecticut River as a weekend or longer trip.

The Vernon Dam Project of the Connecticut River eliminates any opportunity for whitewater paddling. There are <u>no</u> levels at this site to provide river play, surfing or currents for squirt boating. There are no flows to provide "freestyle paddling" and the river reach below the dam is devoid of any whitewater challenge.

Issue #1: Mitigation for Impacts of the Connecticut River and Loss of Whitewater Recreation below Vernon Dam

The Vernon Dam project is a 900-foot wide dam that blocks flows completely except for a *"minimum flow of 1,250 cfs or inflow, whichever is less."* Any natural whitewater flows have been eliminated because of the dam. Prior to construction of the dam in 1907, whitewater rapids existed at this site. None of the opportunities eliminated by the project can be restored by the development of a release schedule.

1907 Dam Construction—Note Whitewater Rapids in Background Soon To Be Lost

The current operation of the project eliminates valuable seasonal whitewater paddling opportunities because construction of the downstream Turners Falls Dam (FERC Project No. 1889-081) has resulted in a "river pool," whose primary function is to provide a water source for the Northfield Pumped Storage Project (FERC No. 2485-063).

In the PAD, the Licensee proposes no mitigation for the project's effects on the loss of whitewater recreational use.

Issue # 2: Camping and sanitary facilities available for multiple-day kayaking or canoe trips.

Information provided by canoe clubs and other river recreational interests cite changing demographics and the rise of sea kayaking as reasons for high interest in flatwater paddling and multiple-day canoe trips.

In the PAD, the Licensee cites the Massachusetts SCORP (2006-2011), which indicated a need for "water-based" activities, and one of the goals of the New Hampshire SCORP identified the need for a variety of recreational opportunities. The Vermont SCORP (2005-2009) reveals the need for access to all types of outdoor recreation.

While the applicant has itemized three camping facilities and 14 access points (not all of which are managed by TransCanada) in the reach from immediately below the Vernon Dam and north throughout Project boundaries, they have not provided a qualitative analysis of these facilities. These sites are managed and/or maintained by multiple parties, and at a minimum there should be consistent standards for sanitation, safety, and control of litter or camping debris.

In the PAD, the Licensee proposes no new camping sites or upgrades to existing facilities, nor do they propose any management plans for maintenance or enforcement. They do not attempt to estimate the increased use of such facilities during a 30-year license period.

Issue #3: Economic impacts.

The flow operations and management of the Vernon Dam have significant negative recreational impacts and related socio-economic impacts. Because of the "river pool" no change of the operational scenario of the Vernon Dam Project could or will create new tourism products for a region that is primed to capitalize on it. Retail activity, and food and lodging opportunities are lost because of diminished whitewater recreation and this loss should be studied. There are thousands of people who currently travel to the region each year for whitewater kayaking, canoeing, and rafting activities that would provide added value to the region.

In making a public interest decision, FERC must weigh the value of water in the river held only for power generation, and reach a compensation plan that strikes the appropriate balance for the loss of whitewater opportunities that would provide broader public benefits. In many dam relicensing proceedings, the values of flow restoration are largely recreational and ecological, and thus hard to evaluate in dollars. In this case, because of the significant loss of benefits from whitewater recreational usage, we believe FERC should also weigh the predicted economic values associated with whitewater use when looking at various alternatives.

Study Requests

We hereby request several studies per 18 CFR 5.9(b).

1. Mitigation for Impacts on the Connecticut River and Loss of Whitewater Recreation below Vernon Dam

(1) Describe the goals and objectives of each study proposal and the information to be obtained.

The Vernon Dam itself has completely eliminated whitewater opportunities for paddlers. The goal of this study is to assess the value of whitewater boating resources eliminated by the Project and the development of a suite of on-site and off-site mitigation options that would provide mitigation for the loss of whitewater recreation at the Vernon Dam.

Vernon Rapid Before the Dam--1907

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.

The requester is not a resource agency

(3) If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.

The Vernon Dam effectively eliminates the public's opportunity to enjoy a whitewater boating resource. Conducting the necessary studies and implementing the necessary measures to ensure the public has access to whitewater recreational resources are in the public interest.

Using off-site mitigation has historically been an acceptable practice in FERC licensing. This is evidenced in the Upper Androscoggin Settlement Agreement for the Rapid and Magalloway Rivers in Maine (FERC No. 11834-000), as well as the Canada Falls Settlement Agreement (FERC No. 2634) for the South Branch of the Penobscot River in Maine.

On May 24, 2012, Secretary of the Interior Ken Salazar designated the Connecticut River and Watershed as the nation's first National Blueway. A Memorandum of Understanding signed in August by the Departments of Interior, Agriculture, and the Army has as one objective "providing opportunities for scientific research, environmental education and outdoor recreation and access within the National Blueway to the extent compatible with agency missions."

The National Blueway concept takes a watershed viewpoint and addresses the river from its source to the sea. The goal of the National Blueways System is "to advance a whole river and watershed-wide approach to conservation, outdoor recreation, education, and sustainable economic opportunities in the watersheds in which we live, work, and play." The National Blueway designation includes all the tributaries in the watershed and involves several federal agencies. These agencies include the U.S. Army Corps of Engineers, the Silvio Conte Refuge, U.S. Fish and Wildlife Service, the National Park Service, and the States of Connecticut, Vermont, New Hampshire, and the Commonwealth of Massachusetts, which have prioritized conservation, recreation, and restoration in the 7.2 million-acre Connecticut River Watershed.

Restoration of recreation opportunities in the Connecticut River watershed has the potential to offer the region significant economic benefits.

(4) Describe existing information concerning the subject of the study proposal, and need for additional information.

Current and historic project operations at the Vernon Dam provide no consistent or meaningful information for this type of mitigation. It should be determined what flows in the region are best suited for maximum recreational use.

(5) Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

The Project controls the entire flow in the Connecticut River with the exception of releasing the "*required minimum flow of 1,250 cfs or inflow, whichever is less*" or when generating. The result disrupts regionally needed summer paddling opportunities on the main stem. FERC needs to balance the paddling resource and power generation under the "*Electric Consumers Protection Act"* (*16 U.S. C. §797,803*). The project nexus is direct.

Study results would and should develop the basis of license terms that could protect the public interest and provide the balance mandated under the ECPA.

(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

Analyses would include gathering information to assess options for off-site mitigation. The process steps are generally 1) collaboratively identify candidate rivers and issues with the paddling community, 2) resource agency identification and feasibility assessment, and 3) inter-agency meetings with resource agencies, Licensee, and representatives of the boating community with experience with assessing existing needs of candidate rivers to determine feasibility of proposed measures.

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

We are willing to work with the Licensee on an on-site and off-site mitigation study to keep costs reasonable and the quality of information high. We believe that potential mitigation options can be easily and affordably identified through collaborative discussions. What will be subsequently needed is the integration of this information and organized meetings to study the feasibility of alternatives, and subsequently a written report.

Given the collaborative approach sought by the paddling community, including in-kind contributions of time and expertise, the Licensee and agencies should be able to complete these studies for this unique approach to mitigation for a very reasonable cost.

The Licensee PAD proposes no whitewater recreation mitigation analysis, either on-site or off-site.

2: Camping and sanitary facilities available for multiple-day kayaking or canoe trips. (Recreation Use and Needs).

(1) Describe the goals and objectives of each study proposal and the information to be obtained.

The goal of this study is to provide a quantitative and qualitative analysis of existing facilities to determine their capacity to manage the increasing number of paddlers who are making multiple-day trips on the Connecticut River. This study should also identify other points on the river that would be suitable for the establishment of additional facilities. The adequacy of these facilities over the course of the 30-year license should be assessed.

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;

The requester is not a resource agency.

(3) If the requester is a not resource agency, explain any relevant public interest considerations in regard to the proposed study.

In the PAD, the Licensee cites the Massachusetts SCORP (2006-2011), which indicated a need for "water-based" activities, and one of the goals of the New Hampshire SCORP identified the need for a variety of recreational opportunities. The Vermont SCORP (2005-2009) reveals the need for access to all types of outdoor recreation.

The public has an interest in healthy rivers and streams that fully support the full suite of beneficial uses and other goals of the Clean Water Act. Access to streams and rivers with adequate base flows and sufficient variability will support high-quality recreational use. Information provided by canoe clubs and other river recreational interests cite changing demographics and a rise in sea kayaking and rowing as reasons for high interest in flatwater paddling and multiple-day canoe trips.

The Licensee owns and operates several river access areas on the Connecticut River within project boundaries, and both the states of Vermont and New Hampshire manage additional sites in the vicinity of the Project. Thus, there is a clear interest in the public's ability to traverse the Connecticut River in boats and use developed recreational sites. In addition to this interest, the Connecticut River has been designated at America's first *"Heritage River"* and "*National Blueway."* The National Blueway designation includes interests from the Department of the Interior and the National Park Service.

(4) Describe existing information concerning the subject of the study proposal, and the need for additional information.

While the applicant has itemized three camping facilities and 14 access points available from immediately below the Vernon Dam north throughout Project boundaries, they have not provided a qualitative analysis of these facilities. These sites are managed and/or maintained by multiple parties listed by the Licensee in the PAD. Current management agencies should be surveyed by the Licensee to gather historical management and operational data and then provide plans and upgrades to meet future recreational needs for the 30-50 year life of the proposed license.

One of the better publications available to gather this information is "*The Connecticut River Boating Guide: Source to the Sea,"* published by the Connecticut River Watershed Council, 3rd Edition, 2007.

In the PAD, the Licensee proposes no new camping sites or upgrades to existing facilities, nor do they propose any management plans for maintenance or enforcement.

(5) Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

This study will be the defining mechanism for identifying additional sites and improvements that can best be adapted for the increasing needs of public access and multiple-day paddling trips on the Connecticut River. These might include property the Licensee would be required to purchase in order to fulfill public requirements for camping, put-ins and take-outs, and portages. The nexus is direct.

(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

Our interest is in having sufficient information to understand what facilities exist and what, if any, improvements are necessary to manage an increasing use of multiple-day sea kayak and canoe trips on the Connecticut River. Licensee staff have the resources to complete this analysis and should include recommendations for the acquisition and development of additional facilities to meet the interest and needs identified in the multi-state SCORP documents cited by the Licensee in the PAD. This analysis can be completed during any spring, summer, or fall field season.

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

There are multiple sites along the Connecticut River that are used as access points or have camping facilities. However there are vast differences in the ability or capacity of these sites to handle paddling groups of varying size and numbers or sanitation needs. Beyond the iteration of lists provided by the Licensee in the PAD, there is no comprehensive guide or text that provides updated information. Visual inspection of existing sites, portages, and facilities should take place and any needed reconstruction or rehabilitation of existing facilities should be identified.

Cost of this data collection is relatively minimal and can be completed by Licensee staff. This analysis can be completed during any spring, summer, or fall field season.

Issue #3: Economic impacts.

(1) Describe the goals and objectives of each study proposal and the information to be obtained.

The goal of the recreational economic impact study is to predict the regional economic values of off-site mitigation to provide alternative flow restoration on other regional resources.

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.

The requester is not a resource agency.

(3) If the requester is a not resource agency, explain any relevant public interest considerations in regard to the proposed study.

Economic stimulus from paddling recreation is clearly in the public interest. Many New England hydropower projects support robust recreation economies. This study should examine economic values and benefits for the Vernon facility. Examples of increased economic success following relicensing include projects such as the Kennebec and Rapid Rivers in Maine, and the Moose River in New York.

The Licensee owns and operates several river access areas on the Connecticut River within project boundaries, and both the states of Vermont and New Hampshire manage additional sites in the vicinity of the Project. Thus, there is a clear interest in the public's ability to traverse the Connecticut River in boats and develop recreational uses. In addition to this interest the Connecticut River has been designated at America's first *"Heritage River"* and *"National*

Blueway." The National Blueway designation involves the Department of the Interior, National Park Service, and other federal agencies.

Developing off-site mitigation for the loss of whitewater resources at Vernon Dam would provide economic benefits for the entire region.

(4) Describe existing information concerning the subject of the study proposal, and the need for additional information.

One study was published in 2005 by Crane Associates of Burlington, Vermont: *"The Economic Impacts of Whitewater Boating on the West River, Jamaica, Vermont."* Outside of that study, there is not a great deal of existing information regarding the economic potential of off-site mitigation for the loss of whitewater resources at Vernon Dam. We look forward to learning more.

(5) Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

The project has removed whitewater paddling opportunities throughout the year at Vernon Dam. Many of these days could provide kayaking, instructional paddling, and canoeing, all of which have ancillary economic benefits associated with tourism. The nexus is direct. Understanding the economic values that could be provided by mitigating the loss of paddling recreation at Vernon Dam will assist FERC and other stakeholders in balancing the trade-offs associated with lost generation. In the case of the nearby Deerfield River (FERC No.2334-010), the value of whitewater recreation outweighed the value of power generation by a margin of 24:1.

(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

Since the present economic values of the lost whitewater recreation are unknown because there is currently no whitewater recreational activity at Vernon Dam, we request the study be compiled using the "*contingent valuation*" method study which measures individuals' "*willingness to pay.*" These values can be compared to the value of hydro generation. They can be extrapolated to develop an understanding of how economic benefits associated with paddling activities will be multiplied throughout the community. Overall visitor spending will contribute to economic significance for the immediate and adjacent region.

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

Primary data should be collected through survey instruments circulated through known paddling clubs throughout New England during the winter months. Individual interviews should be taken on days when the nearby West River and Deerfield River are having releases, and the survey should include kayakers, canoeists, and rafters of varying abilities. Customers of commercial outfitters should also participate in the survey as well as outfitters that provide tubing equipment for those individuals that enjoy just floating down the river. The Licensee has proposed no economic studies in the PAD.

Conclusion:

We respectively request the hydrological, recreational, and economic studies that will support the dialog and analysis regarding appropriate mitigation for the loss of recreational resources at the Vernon Dam.

In addition, in these comments we offer our comments on the PAD, to better inform this relicensing process. Thank you for considering these comments.

Respectfully submitted this 28th day of February, 2013

Thomas J. Christopher

____

Thomas J. Christopher, Secretary/Director
New England Flow
252 Fort Pond Inn Road
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Bob Nasdor
____

Bob Nasdor
Northeast Stewardship Director
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_/s/ Norman Sims_________________________

Norman Sims
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16 Linden Ave.
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_/s/ Kenneth Kimball_____________________

Kenneth Kimball
Director of Research
Appalachian Mountain Club
P.O. Box 298
Gorham, NH 03581

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

TransCanada Hydro Northeast, Inc.	Vernon Hydroelectric Project FERC No. 1904-073

CERTIFICATE OF SERVICE

Pursuant to Rule 2010 of the Commission's Rules of Practice and Procedure, I hereby certify that I have this day caused the foregoing NEW ENGLAND FLOW, AMERICAN WHITEWATER, AND THE APPALACHIAN MOUNTAIN CLUB'S COMMENTS AND STUDY REQUESTS IN RESPONSE TO THE NOTICE OF INTENT TO FILE LICENSE APPLICATION, FILING OF PRE-APPLICATION DOCUMENT (PAD), COMMENCEMENT OF PRE-FILING PROCESS, AND SCOPING: REQUEST FOR COMMENTS ON THE PAD AND SCOPING DOCUMENT, AND INDENTIFICATION OF ISSUES AND ASSOCIATED STUDY REQUESTS REGARDING VERNON HYDROELECTRIC PROJECT, FERC PROJECT NO. 1904-073 to be served upon each person designated on the official service list compiled by the Secretary in this proceeding.

Dated this 28th day of February, 2013.

Megan Hooker

Megan Hooker
American Whitewater
Bend, Oregon

Document Content(s)

The State of New Hampshire
Department of Environmental Services

Thomas S. Burack
Commissioner

March 1, 2013

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, D.C. 20426

Subject: Comments on Pre-Application Documents and Study Requests for 5 Hydroelectric Projects on the Connecticut River:
Wilder Project (FERC No. 1892)
Bellows Falls Project (FERC No. 1855)
Vernon Project (FERC No. 1904)
Turners Falls Project (FERC No. 1889)
Northfield Mountain Pumped Storage Project (FERC No. 2485)

Dear Secretary Bose:

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)].

DES has reviewed the Preliminary Application Documents (PADs) and Scoping Document for the following five hydroelectric projects on the Connecticut River:

Wilder Project (FERC No. 1892)
Bellows Falls Project (FERC No. 1855)
Vernon Project (FERC No. 1904)
Turners Falls Project (FERC No. 1889)
Northfield Mountain Pumped Storage Project (FERC No. 2485)

Comments on the PADs and our formal study requests are provided below. In addition to the study requests provided herein, please note that DES also supports the study requests submitted by the New Hampshire Fish and Game Department in a letter dated February 27, 2013 for the Turners Falls and Northfield Mountain Projects (FERC Nos. 1889 and 2485).

DES Web site: **www.des.nh.gov**
P.O. Box 95, 29 Hazen Drive, Concord, New Hampshire 03302-0095
Telephone: (603) 271-3503 • Fax: (603) 271-2867 • TDD Access: Relay NH 1-800-735-2964

We thank you for the opportunity to comment.

Sincerely,

Gregg Comstock

Gregg Comstock, P.E.
Supervisor, Water Quality Planning Section
New Hampshire Department of Environmental Services

I. Preliminary Application Document (PAD) Comments

A. COMMENTS FOR WILDER PROJECT PAD (FERC NO. 1892)

A1. Section 2.3 Project Location

a. Figure 2.1-2 on page 2-3 is blurry and difficult to read.

A2. Section 2.1 Project Facilities

a. Figure 2.3-2 (page 2-9), Figure 2.3-4 (page 2-12), Figure 2.3-5 (page 2-13), Figure 2.3-6 (page 2-15), Figure 2.3-8 (page 2-19) and Figure 2.3-9 (page 2-20) are blurry and difficult to read.

A3. Section 2.4. Project Reservoir

a. Figure 2.4-1 on page 2-24 shows how reservoir volume and surface area varies with elevation. It should be explained how these curves were developed (i.e., were they based on bathymetric mapping of the reservoir?).
b. If available, a similar figure should be developed showing the change in exposed shoreline (average and maximum values in feet) with elevation.
c. Figure 2.4-2 on page 2-25 shows the water surface profiles at various flows. It should be stated how these were determined (i.e., were they based on a model?).
d. On page 2-27 it is stated that reservoir drawdown rates are typically 0.1 to 0.2 feet per hour and do not exceed 0.3 feet per hour. It should be explained why these rates were selected.

A4. Section 2.5.2 Normal Operations

a. On page 2-26, it is stated that the "project operates primarily on a daily run-of- river basis, meaning generally that over the course of a day, its operation passes the average daily inflow", The minimum, average and maximum percent of time that the average daily flow is not passed in 24 hours for each month for the period of record should be stated.
b. A description of maintenance procedures (i.e., refill procedures, how often maintenance is performed, how often it is necessary to draw the dam down below the minimum allowed elevation) should be provided.

A5. Section 2.5.5 High Flow Operation

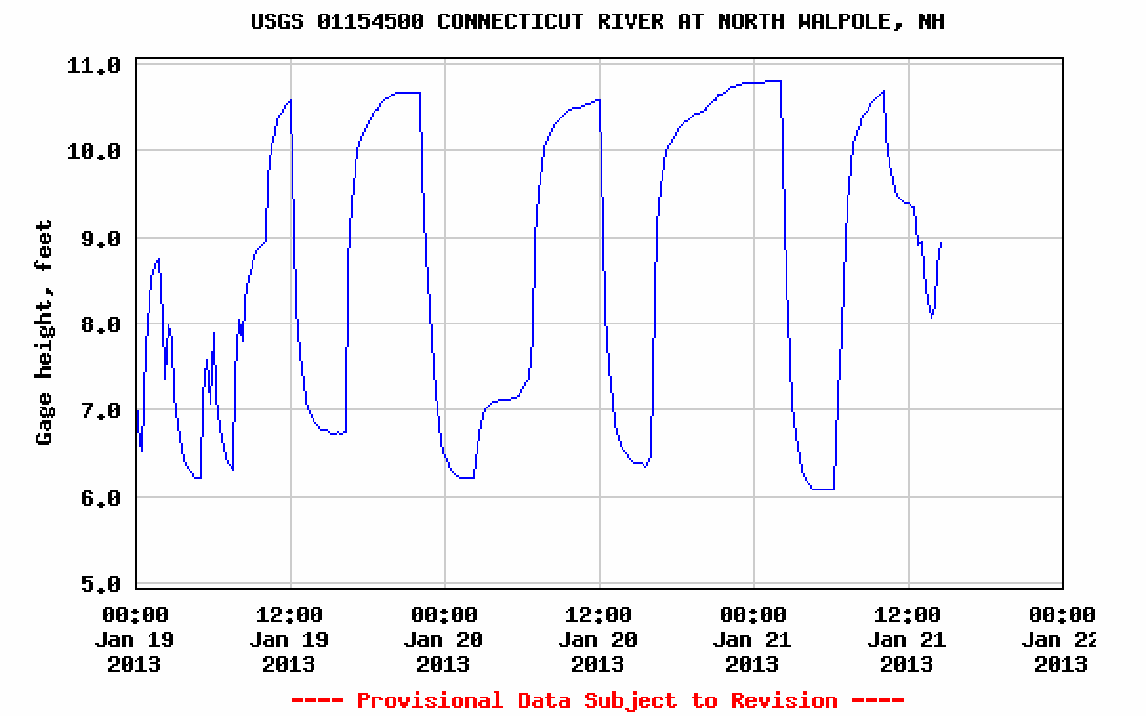
a. On page 2-30, it is stated that on occasion , inflows are anticipated to peak at a level just above station capacity and the reservoir is drawn down in advance to capture and avoid spilling, but these instances are the exception. The minimum, maximum and average percent of time this happens for each month for the period of record should be specified
b. Table 2.5-2 on page 2-31 shows the station discharge capacity at various water surface elevations. The discharge capacity for all the gates and stanchion bays increase with increasing elevation. However, the discharge capacity for the 3 generators decrease with increasing elevation. This should be explained.

A6. Section 2.6.4 Current License and License Amendment Requirements

a. Table 2.6-3 on page 2-36 provides a summary of license and amendment requirements in addition to "Standard" Articles 1 through 28 of the FERC license. It would be helpful to have include a complete summary of all FERC requirements (or perhaps provide a copy of the FERC license as an appendix).

A7. Section 3.4.5 Reservoir Shoreline and Streambanks

a. On page 3-13 it is stated that bank slumping was identified in the Kleinschmidt study (2011) as being the primary type of erosion present. This type of erosion is exacerbated by land/vegetation clearing close to the bank, commonly associated with farming practices. The Kleinschmidt survey concluded that 77 percent of the bank erosion in the Bellows Falls impoundment were associated with agricultural practices. The report does not mention the primary cause of the remaining 23 percent of the erosion sites. It is then concluded that impoundment level fluctuations caused by project operations are not likely to be significant contributors to erosion in the impoundment compared to naturally occurring high flows coupled with highly susceptible soils. It is not clear how such a statement can be made since bank vegetation (and stabilization) is reportedly sparse in the zone impacted by impoundment fluctuations (see section 3.8.3). It follows that this lack of stabilization would contribute to more erosion at all flows as compared to a bank with more vegetation. How much more is not discussed. That is, if the banks were better stabilized with vegetation, how would that reduce erosion under both low and high flows? This section also does not discuss the impact of daily impoundment fluctuations on downstream river fluctuations and erosion, but should. As shown in the graph below (based on the USGS gage located just below the Bellows Falls dam) water levels below the Bellows Falls dam can fluctuate approximately 4 feet twice per day. Similar fluctuations likely occur downstream of the Project dam. It appears more study is needed before statements can be made that suggest that daily impoundment fluctuations are insignificant contributors to erosion.



A8. Section 3.4.6 Project Effects (regarding Geology and Soils)

a. On pages 3-14 and 3-15, it is stated that impoundment fluctuations play a minor role in shoreline erosion, with flood flow from major storms playing a significant role. What does a "minor" role mean? This is a subjective statement that should be quantified. As discussed in the previous comment, it would seem that since Project operations have resulted in sparse growth along the banks and have therefore increased their erosion potential, the impact of the Project on erosion is significant. That is, the amount of erosion would likely be significantly less if there were more vegetation on the banks to stabilize them.

A9. Section 3.5.2 Hydrology

a. Figure 3.5-1 on page 3-20 shows a whisker graph of hourly water level in the impoundment for each month for the period January 1, 2001 to December 31, 2011. A similar plot should be prepared with the maximum daily change in impoundment elevation (in feet) on the y-axis. This would show the frequency and magnitude of the daily fluctuations. If water surface elevation is available downstream of the dam, a similar plot should be developed to show the frequency and magnitude of daily fluctuations downstream.

b. A whisker graph similar to Figure 3.5-1 on page 3-20 but with the y - axis equal to the predicted maximum daily change in impoundment elevation if the project were operated in an instantaneous run-of-river mode, should be developed and compared to the graph requested in comment 6.a. above. This would give an idea of the difference in magnitude and frequency of maximum daily impoundment fluctuations with current operations and with instantaneous run-of-river operations.

c. On page 3-23 it is stated that when inflows are less than station capacity of 10,700 cfs, the Project is operated as a daily peaking project to meet regional electrical demand. The average percent of time each year this occurs should be stated (i.e., 83 percent based on page 2-29 which states that station capacity is exceeded 17 percent of the time).

e. Figure 3.5-6 on page 3-23 shows a plot of the averaged hourly outflow and averaged monthly minimum, maximum and average outflow from January 1, 2001 to December 31, 2011. This graph is difficult to read. It is recommended the plot be expanded. A similar plot but with hourly impoundment elevation on the y-axis is requested to show the frequency, duration and magnitude of impoundment fluctuations. Another plot is requested showing the predicted hourly impoundment elevation if the Project was run in the instantaneous run-of-river mode.

A10. Section 3.5.5 Water Quality Standards - State Standards

a. A note should be added at the bottom of Table 3.5-3 on page 3-26 which states that for impoundments, the dissolved oxygen standards apply to the epilimnion or to the top 25 percent of depth if not stratified.

A11. Section 3.5.6.2 TransCanada Water Quality Studies

a. This section presents a summary of the data collected and concludes (see page 3-33) that the 2012 data are within a range that is typical of large, good quality riverine systems. This statement is subjective and is not supported by any data from other large rivers that are in compliance with state water quality standards. Though there were only pH violations of NH water quality standards (which were most likely due to acidic atmospheric deposition), there were significant increases in temperature within the impoundment and the instantaneous (5mg/L) and average daily percent saturation (75%) DO standards were close to being violated (5.66 mg/L and 77.6% saturation). Unsupported statements such as this should be deleted or modified

b On page 3-33, it is stated that temperature and specific conductivity increased slightly from upstream to downstream in the impoundment. Such subjective terms should be quantified (i.e., include the value of the change for each paramenter). It is further stated that "Generally minor changes in upstream to downstream values of study parameters may reflect the impacts of impoundment of riverine waters, thereby increasing time-of-travel and water column activity.". The word "may" should be deleted from this sentence unless another plausible explanation can be presented..

c. On page 3-34 it is stated that values depicted in table 3.5-11 reflect nutrient loading from upriver wastewater treatment plant discharges but are not considered high enough to cause significant impairment. This statement is not substantiated and should be deleted or revised. Wastewater treatment plant discharges are not the only source of nutrient loadings. Examples of other possible sources of nutrient loading are stormwater runoff, and nutrients in sediment or soils eroding into the river.
d. The report should discuss if the impoundment became stratified or not and provide profiles of DO and temperature with depth to support any conclusions. DES considers a surface water stratified when there is a defined thermocline showing greater than a 1 degree (Celcius) change per meter.
e. To determine if the data is representative of near worse case conditions (i.e., when parameters such as temperature, DO and algal activity are likely to be highest), this section should indicate what the flow was in the river and bypass channel prior to and during sampling. A comparison of the flow to the 7Q10 low flow should also be included in the discussion. Plots showing the flow and sampling results with time would be helpful.
f. To facilitate data analysis, DES requests that the data be uploaded in the DES Environmental database.

A12. Section 3.5.7 Project Effects on Seasonal Variation of Water Quality

a. On page 3.5.7 it is stated that the "Project has no significant impact on the primary water quality parameters of concern, DO, or other physical and chemical parameters." DES does not believe that the information provided in the PAD supports such a broad-sweeping conclusion and should be deleted or modified. As previously discussed (see comment A.11 above), the impoundment is close to violating NH DO standards. Further, since the data was not likely not taken during worse case conditions it is possible violations may be occurring. In addition the data indicates an approximate two degree increase in temperature in the impoundment. This statement also does not appear to consider the potential impact of Project operations on sediment (and associated nutrient) loadings associated with erosion.

A13. Section 3.6.2 Summary of Existing Conditions - Fish Assemblage and Habitat Assessment of the Upper Connecticut River

a. Figure 3.6-2 on pages 3-49 and 3-50, shows the Index of Biological Integrity (IBI) results for the Project area based on sampling conducted in 2008 (and reported by Yoder et. al. in 2009) . Results were analyzed using three indices: the Atlantic Slope IBI, the Interim Maine Rivers IBI and the Modified Index of Well-Being. Two of the indices (Interim Maine Rivers IBI and the Modified Index of Well-Being) showed lower values just upstream of the dam. Moving further upstream, however, the values increase and then decrease again near the upstream portions of the project. No explanation is provided for this behavior. For example, what is the impact of impoundment fluctuations on the results? Also, what is considered a good and poor IBI score? If available, this information should be included in the discussion.

A14. Section 3.6.2 Summary of Existing Conditions - Connecticut River Fish Tissue Contaminant Study

a. This section discusses the result of the Hellyer (2006) Connecticut River Fish Tissue Contaminant Study. Page 3-51 provides a general discussion on total mercury concentrations found in smallmouth bass, white sucker and yellow perch. Graphs and or tables showing actual results in each reach and river mile (with dam locations indicated) should be provided to allow the reader to quantify terms used in this section such as "generally similar" and "higher than".

b. This section (or perhaps a new section) should also discuss the potential impacts of impoundment fluctuations due to Project operations on methylmercury formation (the bioavailable form) and how this can result in increased mercury concentrations in fish and other organisms.

A15. Section 3.6.6 Aquatic Habitat

a. Figure 3.6-6 on page 3-77 shows Qualitative Habitat Evaluation Index (QHEI) scores for various reaches of the Connecticut River. The discussion on page 3-76 states that the QHEI has been shown to correspond predictably with key attributes of fish assemblage quality however, no indication is given of what is considered a good or bad QHEI score. This information should be provided.

A16. Section 3.6.7 Mussels and Macroinvertebrates

a. On page 3-71 it is stated that the dwarf wedgemussel is a federal and state endangered species in New Hampshire and Vermont. On page 3-69 it is stated that 39 dwarf wedgemussels were found from 27 to 41 miles upstream of the dam. This section should include a discussion of how Project operations may be impacting the dwarf wedgemussels and what could be done to increase the population of this endangered species.
b. On page 3-71 it is stated that National Rivers and Streams Assessment (NRSA) collected baseline benthic macroinvertebrate at two locations in the Project impoundment in 2008 and 2009; Station FW08NH009 in Lyme (17 miles upstream of the Wilder dam) and Station FB08NH020 in Haverhill (41 miles upstream of the dam). It is further reported that EPA will develop indices to rate the condition of each site as good, fair or poor and that the final report is due out by the end of 2012. Please note that based on preliminary results provided by EPA, it is our understanding that both the Lyme and Haverhill sites will be rated as poor.

A17. Section 3.6.8 Project Effects (regarding Fish and Aquatic Resources)

a. On page 3-75 it is stated that the normal reservoir operating range of approximately 2.5 feet daily in the Project impoundment minimizes fluctuations that could affect fish spawning habitat. It is not clear why a 2.5 foot fluctuation minimizes impacts on fish spawning habitat as compared to smaller fluctuations or instantaneous run-of-river operation. This should be explained or this sentence deleted.
b. On page 3-75 it is stated that threats to mussel species and macroinvertebrates include stranding from water level fluctuations, sedimentation, and erosion. DES concurs that these impacts are or are likely to be occurring. The next sentence states that because no changes are proposed to Project operations, no new effects on aquatic resources are anticipated. There should be a discussion on what can be done to improve aquatic conditions for species, including, but not limited to, the endangered dwarf wedgemussel.

A18. Section 3.7.3 Plant and Animal Species

a. Table 3.7-4 on page 3-96 (invasive plant species) should include invasive alga *Didymosphenia geminata* (freshwater planktonic alga) and invasive aquatic macrophyte *Najas minor* (submersed).

A19. Section 3.7.4 Project Status (regarding Wildlife and Botanical Resources)

a. On page 3-98 it is stated that potential effects of the Project to wildlife and botantical resources can occur as a result of hydroelectric operations. The daily water level fluctuations of approximately 2.5 vertical feet has resulted in a zone of sparse vegetation, along most of the shorelines of the impoundment. Wetland or water dependent wildlife and plant species will be adversely affected by the daily wetting and drying cycles along the river's edge. Disturbance resulting at least partially from project operations also creates opportunities for invasive plant species to colonize and dominate the shorelines of the project. DES concurs that these impacts are or are likely to be occurring. This section further states that because no changes are proposed to Project operations, no new effects on wildlife and botanical resources are anticipated. Since impacts of Project operations have been acknowledged in the PAD, there should be a discussion on what can be done to improve conditions rather than continuing with the status quo.

A20. Section 3.8.1 Summary of Existing Conditions (regarding Wetlands, Riparian, Littoral and Floodplain Habitat)

a. On page 3-99 it is stated that mapping by the National Wetlands Inventory (NWI) was the primary source for describing the wetland and littoral vegetated habitats for the Project. Actual wetland mapping would provide a more accurate baseline. Are there any plans to perform wetland mapping in the Project area?

A21. Section 3.8.3 Project Status (regarding Wetlands, Riparian, Littoral and Floodplain Habitat)

a. On page 3-104 it is stated that potential effects of the Project on wetland, floodplain, riparian, and littoral resources can occur as a result of hydroelectric operations. The average daily water level fluctuation of approximately 2.5 vertical feet has resulted in a zone of sparse vegetation along most shorelines of the impoundment. Wetland and littoral resources in this zone are limited by the frequent wetting and drying. DES concurs that these impacts are or are likely to be occurring. This section further states that because no changes are proposed to Project operations, no new effects on wetland, floodplain, riparian, and littoral resources are anticipated. Since impacts of Project operations have been acknowledged in the PAD, there should be a discussion on what can be done to improve conditions rather than continuing with the status quo.

A22. Section 3.9.5 Project Status (regarding Rare, Threatened and Endangered Species)

a. On pages 3-112 and 3-113 it is stated that potential effects of the Project on RTE species or communities can occur as a result of hydroelectric operations. Project impacts on dwarf wedgemussel can occur as a result of river fragmentation, impoundment and hydroelectric operations. The project impoundment results in a more lentic environment characterized by reduced current speed and complexity, and increased sedimentation, and therefore reduced substrate complexity/increased substrate embeddedness. Peaking project operations alter the flow regime downstream of the Project, which alters downstream habitat on a sub-daily time scale and could impact feeding, spawning, and recruitment. DES concurs that these impacts are or are likely to be occurring. This section further states that because no changes are proposed to Project operations, no new effects on rare state, or federal terrestrial plant species or communities are anticipated. Since impacts of Project operations have been acknowledged in the PAD, there should be a discussion on what can be done to improve conditions rather than continuing with the status quo.

B. COMMENTS FOR THE BELLOWS FALLS PROJECT PAD (FERC NO. 1855)

B1. Section 2.3 Project Location

a. Figure 2.1-2 on page 2-3 is blurry and difficult to read.

B2. Section 2.1 Project Facilities

a. Figure 2.3-2 (page 2-9), Figure 2.3-4 (page 2-11), Figure 2.3-6 (page 2-14), Figure 2.3-7 (page 2-15), Figure 2.3-9 (page 2-19) and Figure 2.3-11 (page 2-21) are blurry and difficult to read.

B3. Section 2.4. Project Reservoir

a. On page 2-24 the useable storage at a drawdown of 3 feet (288.63) is provided which we understand is the maximum allowed drawdown for this project, yet this section also provides the maximum useable storage for a 4 foot drawdown. It is not clear why this was provided when the maximum allowable drawdown is 3 feet.
b. Figure 2.4-1 shows how reservoir volume and surface area varies with elevation. It should be explained how these curves were developed (i.e., were they based on bathymetric mapping of the reservoir?).
c. If available, a similar figure should be developed showing the change in exposed shoreline (average and maximum values in feet) with elevation.
d. Figure 2.4-2 on page 2-26 shows the water surface profiles at various flows. It should be stated how these were determined (i.e., were they based on a model?).
e. On page 2-27 it is stated that reservoir drawdown rates are typically 0.1 to 0.2 feet per hour and do not exceed 0.3 feet per hour. It should be explained why these rates were selected.

B4. Section 2.5.2 Normal Operations

a. On page 2-27, it is stated that the "project operates primarily on a daily run-of- river basis, meaning generally that over the course of a day, its operation passes the average daily inflow", The minimum, average and maximum percent of time that the average daily flow is not passed in 24 hours for each month for the period of record should be stated.
b. A description of maintenance procedures (i.e., refill procedures, how often maintenance is performed, how often it is necessary to draw the dam down below the minimum allowed elevation) should be provided.

B5. Section 2.5.5 High Flow Operation

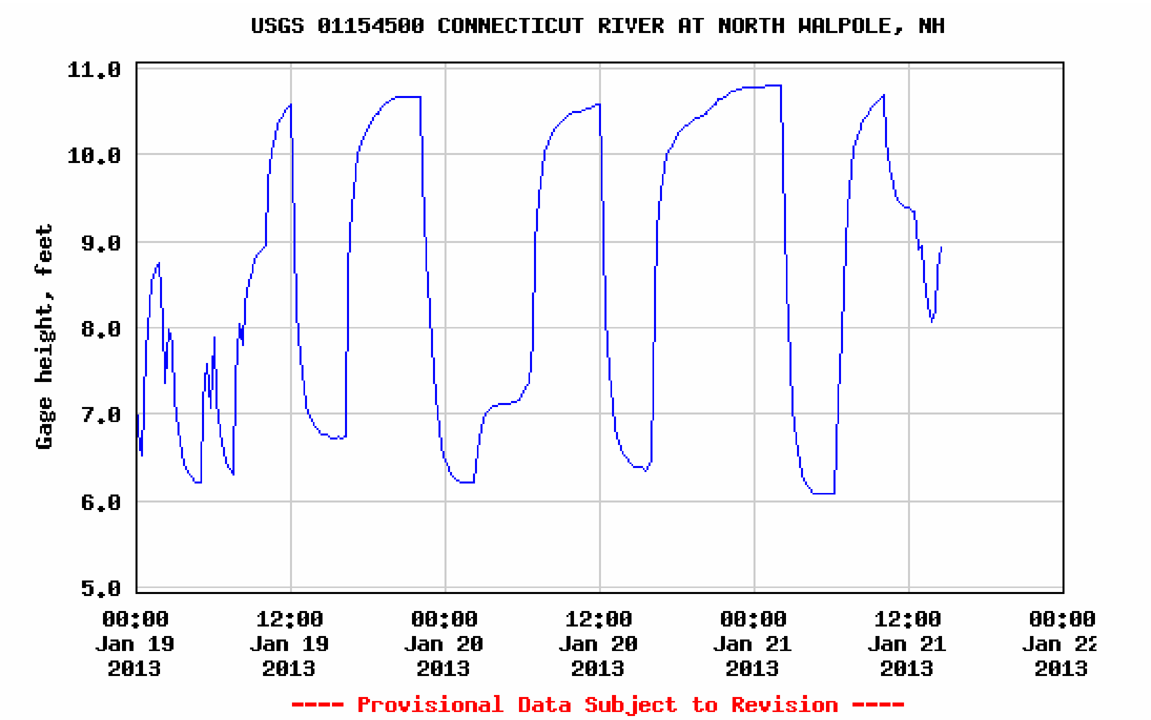
a. On page 2-30, it is stated that on occasion , inflows are anticipated to peak at a level just above station capacity and the reservoir is drawn down in advance to capture and avoid spilling, but these instances are the exception. The minimum, maximum and average percent of time this happens for each month for the period of record should be specified
b. Table 2.5-2 on page 2-31 shows the station discharge capacity at various water surface elevations. The discharge capacity for all the gates and stanchion bays increase with increase elevation. However, the discharge capacity for the 3 generators decrease with increasing elevation. This should be explained.

B6. Section 2.6.4 Current License and License Amendment Requirements

a. Table 2.6-3 on page 2-36 provides a summary of license and amendment requrements in addition to "Standard" Articles 1 through 28 of the FERC license. It would be helpful to have include a complete summary of all FERC requirements (or perhaps provide a copy of the FERC license as an appendix).

B7. Section 3.4.5 Reservoir Shoreline and Streambanks

a. On page 3-13 it is stated that bank slumping was identified in the Kleinschmidt study (2011) as being the primary type of erosion present. This type of erosion is excacerbated by land/vegetation clearing close to the bank, commonly associated with farming practices. The Kleinschmidt survey concluded that 54 percent of the bank erosion in the Bellows Falls impoundment were associated with agricultural practices. The report does not mention the primary cause of the remaining 46 percent of the erosion sites. It is then concluded that impoundment level fluctuations caused by project operations are not likely to be significant contributors to erosion in the impoundment compared to naturally occurring high flows coupled with highly susceptible soils. It is not clear how such a statement can be made since bank vegetation (and stabilization) is reportedly sparse in the zone impacted by impoundment fluctuations (see section 3.8.3). It follows that this lack of stabilization would contribute to more erosion at all flows as compared to a bank with more vegetation. How much more is not discussed. That is, if the banks were better stabilized with vegetation, how would that reduce erosion under both low and high flows? This section also does not discuss the impact of daily impoundment fluctuations on downstream river fluctuations and erosion, but should. As shown in the graph below (based on the USGS gage located just below the Bellows Falls dam) water levels below the dam can fluctuate approximately 4 feet twice per day. It appears more study is needed before statements can be made that suggest that daily impoundment fluctuations are insignificant contributors to erosion.



B8. Section 3.4.6 Project Effects (regarding Geology and Soils)

a. On pages 3-14 and 3-15, it is stated that impoundment fluctuations play a minor role in shoreline erosion, with flood flow from major storms playing a significant role. What does a "minor" role mean? This is a subjective statement that should be quantified. As discussed in the previous comment, it would seem that since Project operations have resulted in sparse growth along the banks and have therefore increased their erosion potential, the impact of the Project on erosion is significant. That is, the amount of erosion would likely be significantly less if there were more vegetation on the banks to stabilize them.

B9. Section 3.5.2 Hydrology

a. Figure 3.5-1 on page 3-19 shows a whisker graph of hourly water level in the impoundment for each month for the period January 1, 2001 to December 31, 2011. A similar plot should be prepared with the maximum daily change in impoundment elevation (in feet) on the y-axis. This would show the frequency and magnitude of the daily fluctuations. A similar graph should also be prepared using the USGS gage No. 01154500 - Connecticut River, North Walpole NH, located just downstream of the Bellows Falls dam. This would provide a better idea of the frequency and magnitude of daily fluctuations up and downstream of the dam.

b. A whisker graph similar to Figure 3.5-1 on page 3-19 but with the y - axis equal to the predicted maximum daily change in impoundment elevation if the project were operated in an instantaneous run-of-river mode , should be developed and compared to the graph requested in comment 6.a. above. A similar plot should then be developed assuming instantaneous run-of-river at both the Wilder and Bellows Falls projects. This would give an idea of the difference in magnitude and frequency of maximum daily impoundment fluctuations with current operations and with instantaneous run-of-river operations

c. On page 3-19 it is stated that for Tropical Storm Irene, the minimum reservoir level was 283.5 due to the need to pull two bays of stanchions and a portion of a third. It should be stated how long the impoundment was at this level (i.e., how long it took to fix the stanchions) and how long it took before the impoundment was at normal pool.

d. On page 3-22 it is stated that when inflows are less than station capacity of 11,400 cfs, the Project is operated as a daily peaking project to meet regional electrical demand. The average percent of time each year this occurs should be stated (i.e., 69 percent based on page 2-30 which states that station capacity is exceeded 31 percent of the time).

e. Figure 3.5-6 on page 3-23 shows a plot of the averaged hourly outflow and averaged monthly minimum, maximum and average outflow from January 1, 2001 to December 31, 2011. This graph is difficult to read. It is recommended the plot be expanded. A similar plot but with hourly impoundment elevation on the y-axis is requested to show the frequency, duration and magnitude of impoundment fluctuations. Another plot is requested showing the predicted hourly impoundment elevation if the Bellows Falls project was run in the instantaneous run-of-river mode and then another plot assuming both the Wilder and Bellows Falls projects were run in the instantaneous run-of-river mode.

B10. Section 3.5.5 Water Quality Standards - State Standards

a. A note should be added at the bottom of Table 3.5-3 on page 3-26 which states that for impoundments, the dissolved oxygen standards apply to the epilimnion or to the top 25 percent of depth if not stratified.

B11. Section 3.5.6.2 TransCanada Water Quality Studies

a. This section presents a summary of the data collected and concludes (see page 3-34) that although there were a few violations of state water quality standards, the 2012 data are within a range that is typical of large, good quality riverine systems. This statement is subjective and is not supported by any data from other large rivers that are in compliance with state water quality standards. Unsupported statements such as this should be deleted or modified.

b On page 3-33, it is stated that temperature and specific conductivity increased slightly from upstream to downstream in the impoundment. Such subjective terms should be quantified (i.e., include the value of the change for each paramenter). It is further stated that "Generally minor changes in upstream to downstream values of study parameters may reflect the impacts of impoundment of riverine waters, thereby increasing time-of-travel and water column activity.". The word "may" should be deleted from this sentence unless another plausible explanation can be presented..

c. On page 3-34, it is stated that BF-01 exceeded NH water quality standards for pH. Based on Table 3.5-8, station BF-BR also exceeded NH pH standards. This should be added to the report. The report states that the high pH readings were measured on 7/12/12 and are most likely due to algal activity since DO levels were well above saturation at the time (120%). The report should add that this is supported by the chlorophyll-a data presented in Table 3.5-11 which shows chlorophyll-a increasing from 3.8 to 6.6 mg/m3 from 7/11/12 to 7/18/2012.
d. On page 3-35 it is stated that values depicted in table 3.5-11 reflect nutrient loading from upriver wastewater treatment plant discharges but are not considered high enough to cause significant impairment. This statement is not substantiated and should be deleted or revised. Wastewater treatment plant discharges are not the only source of nutrient loadings. Examples of other possible sources of nutrient loading are stormwater runoff, and nutrients in sediment or soils eroding into the river.
e. As reported, in addition to pH, violations of NH water quality standards also occurred for DO in one of the weekly profiles for BF-01.
f. The report should discuss if the impoundment became stratified or not and provide profiles of DO and temperature with depth to support any conclusions. DES considers a surface water stratified when there is a defined thermocline showing greater than a 1 degree (Celcius) change per meter.
g. To determine if the data is representative of near worse case conditions (i.e., when parameters such as temperature, DO and algal activity are likely to be highest), this section should indicate what the flow was in the river and bypass channel prior to and during sampling. A comparison of the flow to the 7Q10 low flow should also be included in the discussion. Plots showing the flow and sampling results with time would be helpful.
h. To facilitate data analysis, DES requests that the data be uploaded in the DES Environmental database.

B12. Section 3.5.6.3 Section 303(d) Listing, Non-compliant Waters and TMDLs

a. The following revisions should be made to Table 3.5-12 on pages 3-37 and 3-38:
   - The AUID for the Bellows Falls Impoundment in the 2012 and 2010 cycles should be NHIMP801060703-05 (not NHIMP801060703-5).
   - The AUID for "From RR Bridge, Lebanon to confluence Mascoma River" for the 2010 cycle should be NHRIV801060302-01 (not RIV801060302-01). This impairment should also be added to the 2012 cycle.
b. The discussion regarding Commissary Brook on page 3-36 (last paragraph) states that "New Hampshire DES found that the sediment deposits.....". Since Commissary Brook is listed by Vermont as impaired, "New Hampshire DES" should be deleted and probably be replaced with "Vermont DEC" (confirm with Vermont DEC).

B13. Section 3.5.7 Project Effects on Seasonal Variation of Water Quality

a. On page 3.5.7 it is stated that the "Project has no significant impact on the primary water quality parameters of concern, DO, or other physical and chemical parameters." DES does not believe that the information provided in the PAD supports such a broad-sweeping conclusion and should be deleted or modified. As previously discussed (see comment B.11 above), the impoundment appears to be contributing to violations of pH and possibly DO. Further, since the data was most likely not taken during worse case conditions it is possible additional violations may be occurring. In addition the data indicated almost a two degree increase in temperature in the impoundment and DO supersaturation reflective of significant chlorophyll-a levels. This statement also does not appear to consider the potential impact of Project operations on sediment (and associated nutrient) loadings associated with erosion.

B14. Section 3.6.2 Summary of Existing Conditions - Fish Assemblage and Habitat Assessment of the Upper Connecticut River

a. Figure 3.6-2 on pages 3-51 and 3-52, show Index of Biological Integrity (IBI) results for the Project area based on sampling conducted in 2008 (and reported by Yoder et. al. in 2009) . Results were analyzed using three indices: the Atlantic Slope IBI, the Interim Maine Rivers IBI and the Modified Index of Well-Being. Two of the indices (Interim Maine Rivers IBI and the Modified Index of Well-Being) showed lower values just upstream of the dam. Moving further upstream, however, the values increase and then decrease again near the upstream portions of the project. No explanation is provided for this behavior. For example, what is the impact of impoundment fluctuations on the results? Also, what is considered a good and poor IBI score? If available, this information should be included in the discussion.

B15. Section 3.6.2 Summary of Existing Conditions - Connecticut River Fish Tissue Contaminant Study

a. This section discusses the result of the Hellyer (2006) Connecticut River Fish Tissue Contaminant Study. Pages 3-54 and 3-55 provide a general discussion on total mercury concentrations found in smallmouth bass, white sucker and yellow perch. Graphs and or tables showing actual results in each reach and river mile (with dam locations indicated) should be provided to allow the reader to quantify terms used in this section such as "generally similar" and "higher than".
b. This section (or perhaps a new section) should also discuss the potential impacts of impoundment fluctuations due to Project operations on methylmercury formation (the bioavailable form) and how this can result in increased mercury concentrations in fish and other organisms.

B16. Section 3.6.6 Aquatic Habitat

a. Figure 3.6-8 on page 3-77 shows Qualitative Habitat Evaluation Index (QHEI) scores for various reaches of the Connecticut River. The discussion on page 3-76 states that the QHEI has been shown to correspond predictably with key attributes of fish assemblage quality however, no indication is given of what is considered a good or bad QHEI score. This information should be provided.

B17. Section 3.6.7 Mussels and Macroinvertebrates

a. On page 3-81 it is stated that the dwarf wedgemussel is a federal and state endangered species in New Hampshire and Vermont. On page 3-80 it is stated that of the nine species of mussels found in the Project area, dwarf wedgemussels were the least abundant. This section should include a discussion of how Project operations may be impacting the dwarf wedgemussels and what could be done to increase the population of this endangered species.
b. On page 3-82 it is stated that National Rivers and Streams Assessment (NRSA) collected baseline benthic macroinvertebrate at two locations in the Project impoundment in 2008 and 2009; Station FW08NH011 in Claremont (17 miles upstream of the Bellows Falls dam) and Station FB08NH017 in Cornish (24 miles upstream of the dam). It is further reported that EPA will develop indices to rate the condition of each site as good, fair or poor and that the final report is

due out by the end of 2012. Please note that based on preliminary results provided by EPA it is our understanding the Cornish site will be rated as good and the Clarement site (closer to the dam) will be rated as poor.

B18. Section 3.6.8 Project Effects (regarding Fish and Aquatic Resources)

a. On page 3-85 it is stated that the normal reservoir operating range of approximately 2.5 feet daily in the Project impoundment minimizes fluctuations that could affect fish spawning habitat. It is not clear why a 2.0 foot fluctuation minimizes impacts on fish spawning habitat as compared to smaller fluctuations or instantaneous run-of-river operation. This should be explained or this sentence deleted.

b. On page 3-85 it is stated that threats to mussel species and macroinvertebrates include stranding from water level fluctuations, sedimentation, and erosion. DES concurs that these impacts are or are likely to be occurring. The next sentence states that because no changes are proposed to Project operations, no new effects on aquatic resources are anticipated. There should be a discussion on what can be done to improve aquatic conditions for species, including, but not limited to, the endangered dwarf wedgemussel.

B19. Section 3.7.3 Plant and Animal Species

a. Table 3.7-5 on page 3-106 (invasive plant species) should include invasive alga *Didymosphenia geminata* (freshwater planktonic alga) and invasive aquatic macrophyte *Najas minor* (submersed).

B20. Section 3.7.4 Project Status (regarding Wildlife and Botanical Resources)

a. On page 3-108 it is stated that potential effects of the Project to wildlife and botantical resources can occur as a result of hydroelectric operations. The daily water level fluctuations of approximately 2 vertical feet has resulted in a zone of sparse vegetation, specific to the operating range, along most of the shorelines of the terrestrial project area. Wetland or water dependent wildlife and plant species will be adversely affected by the daily wetting and drying cycles along the river's edge. Areas of erosion along the riverbank can result in impacts to floodplains and riparian habitats. Disturbance resulting at least partially from project operations also creates opportunities for invasive plant species to colonize and dominate the shorelines of the project. DES concurs that these impacts are or are likely to be occurring. This section further states that because no changes are proposed to Project operations, no new effects on wildlife and botanical resources are anticipated. Since impacts of Project operations have been acknowledged in the PAD, there should be a discussion on what can be done to improve conditions rather than continuing with the status quo.

B21. Section 3.8.1 Summary of Existing Conditions (regarding Wetlands, Riparian, Littoral and Floodplain Habitat)

a. On page 3-109 it is stated that mapping by the National Wetlands Inventory (NWI) was the primary source for describing the wetland and littoral vegetated habitats for the Project. Actual wetland mapping would provide a more accurate baseline. Are there any plans to perform wetland mapping in the Project area?

B22. Section 3.8.3 Project Status (regarding Wetlands, Riparian, Littoral and Floodplain Habitat)

a. On page 3-115 it is stated that potential effects of the Project on wetland, floodplain, riparian, and littoral resources can occur as a result of hydroelectric operations. The normal daily water level fluctuation of approximately 2 vertical feet has resulted in a zone of sparse vegetation along most shorelines of the impoundment. Wetland and littoral resources in this zone are limited by the frequent wetting and drying. Areas of erosion along the riverbank can result impacts to floodplains and riparian habitats. DES concurs that these impacts are or are likely to be occurring. This section further states that because no changes are proposed to Project operations, no new effects on wetland, floodplain, riparian, and littoral resources are anticipated. Since impacts of Project operations have been acknowledged in the PAD, there should be a discussion on what can be done to improve conditions rather than continuing with the status quo.

B23. Section 3.9.5 Project Status (regarding Rare, Threatened and Endangered Species)

a. On page 3-124 it is stated that potential effects of the Project on RTE species or communities can occur as a result of hydroelectric operations. Project impacts on dwarf wedgemussel can occur as a result of river fragmentation, impoundment and hydroelectric operations. The project impoundment results in a more lentic environment characterized by reduced current speed and complexity, and increased sedimentation, and therefore reduced substrate complexity/increased substrate embeddedness. Peaking project operations alter the flow regime downstream of the Project, which alters downstream habitat on a sub-daily time scale and could impact feeding, spawning, and recruitment. DES concurs that these impacts are or are likely to be occurring. This section further states that because no changes are proposed to Project operations, no new effects on rare state, or federal terrestrial plant species or communities are anticipated. Since impacts of Project operations have been acknowledged in the PAD, there should be a discussion on what can be done to improve conditions rather than continuing with the status quo.

C. COMMENTS FOR THE VERNON PROJECT PAD (FERC NO. 1904)

C1. Section 2.3 Project Location

a. Figure 2.1-2 on page 2-3 is blurry and difficult to read.

C2. Section 2.1 Project Facilities

a. Figure 2.3-2 (page 2-9), Figure 2.3-4 (page 2-13), Figure 2.3-5 (page 2-16), Figure 2.3-7 (page 2-19), Figure 2.3-8 (page 2-20) and Figure 2.3-9 (page 2-22) are blurry and difficult to read.

C3. Section 2.4. Project Reservoir

a. Figure 2.4-1 on page 2-26 shows how reservoir volume and surface area varies with elevation. It should be explained how these curves were developed (i.e., were they based on bathymetric mapping of the reservoir?).
b. If available, a similar figure should be developed showing the change in exposed shoreline (average and maximum values in feet) with elevation.
c. Figure 2.4-2 on page 2-27 shows the water surface profiles at various flows. It should be stated how these were determined (i.e., were they based on a model?).
d. On page 2-27 it is stated that reservoir drawdown rates are typically 0.1 to 0.2 feet per hour and do not exceed 0.3 feet per hour. It should be explained why these rates were selected.

C4. Section 2.5.2 Normal Operations

a. On page 2-28, it is stated that the "project operates primarily on a daily run-of- river basis, meaning generally that over the course of a day, it's operation passes the average daily inflow", The minimum, average and maximum percent of time that the average daily flow is not passed in 24 hours for each month for the period of record should be stated.
b. A description of maintenance procedures (i.e., refill procedures, how often maintenance is performed, how often it is necessary to draw the dam down below the minimum allowed elevation) should be provided.

C5. Section 2.5.5 High Flow Operation

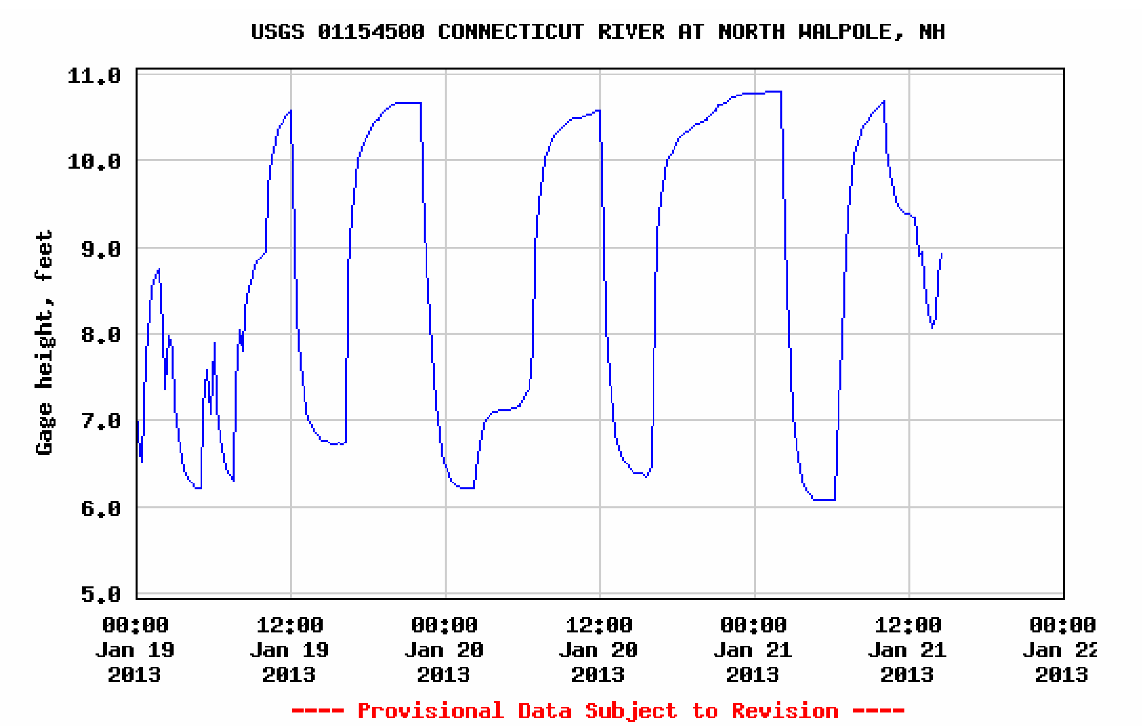
a. On page 2-31, it is stated that on occasion , inflows are anticipated to peak at a level just above station capacity and the reservoir is drawn down in advance to capture and avoid spilling, but these instances are the exception. The minimum, maximum and average percent of time this happens for each month for the period of record should be specified
b. Table 2.5-2 on page 2-32 shows the station discharge capacity at various water surface elevations. The discharge capacity for all the gates and stanchion bays (except the 8 hydraulic floodgates which are submerged at the maximum pond elevation of 228.1), increase as the impoundment water surface elevation increasees. However, the discharge capacity of the generators, drops from 21,000 cfs at pond elevation 220.1 to 0 cfs at pond elevation 228.1. This should be explained.

C6. Section 2.6.4 Current License and License Amendment Requirements

a. Table 2.6-3 on page 2-38 provides a summary of license and amendment requirements in addition to "Standard" Articles 1 through 28 of the FERC license. It would be helpful to include a complete summary of all FERC requirements (or perhaps provide a copy of the FERC license as an appendix).

C7. Section 3.4.5 Reservoir Shoreline and Streambanks

a. On page 3-13 it is stated that bank slumping was identified in the Kleinschmidt study (2011) as being the primary type of erosion present. This type of erosion is exacerbated by land/vegetation clearing close to the bank, commonly associated with farming practices. The Kleinschmidt survey concluded that 47 percent of the bank erosion in the Bellows Falls impoundment were associated with agricultural practices. The report does not mention the primary cause of the remaining 53 percent of the erosion sites. It is then concluded that impoundment level fluctuations caused by project operations are not likely to be significant contributors to erosion in the impoundment compared to naturally occurring high flows coupled with highly susceptible soils. It is not clear how such a statement can be made since bank vegetation (and stabilization) is reportedly sparse in the zone impacted by impoundment fluctuations (see section 3.8.3). It follows that this lack of stabilization would contribute to more erosion at all flows as compared to a bank with more vegetation. How much more is not discussed. That is, if the banks were better stabilized with vegetation, how would that reduce erosion under both low and high flows? This section also does not discuss the impact of daily impoundment fluctuations on downstream river fluctuations and erosion, but should. As shown in the graph below (based on the USGS gage located just below the Bellows Falls dam) water levels below the Bellows Falls dam can fluctuate approximately 4 feet twice per day. Similar fluctuations likely occur downstream of the Project dam. It appears more study is needed before statements can be made that suggest that daily impoundment fluctuations are insignificant contributors to erosion. It appears more study is needed before statements can be made that suggest that daily impoundment fluctuations are insignificant contributors to erosion.



C8. Section 3.4.6 Project Effects (regarding Geology and Soils)

a. On page 3-14, it is stated that impoundment fluctuations play a minor role in shoreline erosion, with flood flow from major storms playing a significant role. What does a "minor" role mean?

This is a subjective statement that should be quantified. As discussed in the previous comment, it would seem that since Project operations have resulted in sparse growth along the banks and have therefore increased their erosion potential, the impact of the Project on erosion is significant. That is, the amount of erosion would likely be significantly less if there were more vegetation on the banks to stabilize them.

C9. Section 3.5.2 Hydrology

a. On page 3-17, it is stated that upper reaches of the Turners Falls reservoir extend to the base of the Vernon dam. Please explain how this was determined. It is our understanding that at the scoping meeting FirstLight indicated that their project assessment may provide evidence that the upstream extent of the Turners Falls impoundment may not reach all the way to the Vernon dam. As discussed below (see comment C15 regarding section 3.6.6), there is data that suggests it may be more riverine.

b. Figure 3.5-1 on page 3-18 shows a whisker graph of hourly water level in the impoundment for each month for the period January 1, 2001 to December 31, 2011. A similar plot should be prepared with the maximum daily change in impoundment elevation (in feet) on the y-axis. This would show the frequency and magnitude of the daily fluctuations. If water surface elevation is available downstream of the dam, a similar plot should be developed to show the frequency and magnitude of daily fluctuations downstream.

c. A whisker graph similar to Figure 3.5-1 on page 3-18 but with the y - axis equal to the predicted maximum daily change in impoundment elevation if the project were operated in an instantaneous run-of-river mode , should be developed and compared to the graph requested in comment 6.a. above. A similar plot should then be developed assuming instantaneous run-of-river at the Wilder, Bellows Falls and Vernon projects. This would give an idea of the difference in magnitude and frequency of maximum daily impoundment fluctuations with current operations and with instantaneous run-of-river operations

d. On page 3-19 it is stated that for Tropical Storm Irene, the minimum reservoir level was 212.0 and that the river must reach the concrete crest, in order to reposition the stanchion beams and reconstruct the retention structure. It should be stated how long the impoundment was at this level (i.e., how long it took to fix the stanchions) and how long it took before the impoundment was at normal pool.

e. On page 3-22 it is stated that when inflows are less than station capacity of 11,400 cfs, the Project is operated as a daily peaking project to meet regional electrical demand. The average percent of time each year this occurs should be stated (i.e., 80 percent based on page 2-31 which states that station capacity is exceeded 20 percent of the time).

f. Figure 3.5-6 on page 3-23 shows a plot of the averaged hourly outflow and averaged monthly minimum, maximum and average outflow from January 1, 2001 to December 31, 2011. This graph is difficult to read. It is recommended the plot be expanded. A similar plot but with hourly impoundment elevation on the y-axis is requested to show the frequency, duration and magnitude of impoundment fluctuations. Another plot is requested showing the predicted hourly impoundment elevation if the Project was run in the instantaneous run-of-river mode and then another plot assuming the Project, as well as the Wilder and Bellows Falls projects were run in the instantaneous run-of-river mode.

C10. Section 3.5.5 Water Quality Standards - State Standards

a. A note should be added at the bottom of Table 3.5-3 on page 3-26 which states that for impoundments, the dissolved oxygen standards apply to the epilimnion or to the top 25 percent of depth if not stratified.

C11. Section 3.5.6.2 TransCanada Water Quality Studies

a. This section presents a summary of the data collected and concludes (see page 3-33) that there were no violations of state water quality standards and that the 2012 data are within a range that is typical of large, good quality riverine systems. This statement is subjective and is not supported by any data from other large rivers that are in compliance with state water quality standards. Unsupported statements such as this should be deleted or modified

b On page 3-32, it is stated that temperature and specific conductivity increased from upstream to downstream in the impoundment. It is further stated that "Generally minor changes in upstream to downstream values of study parameters may reflect the impacts of impoundment of riverine waters, thereby increasing time-of-travel and water column activity." Subjective terms such as "generally minor" should be quantified (i.e., include the value of the change for each paramenter). In addition, the word "may" should be deleted from this sentence unless another plausible explanation can be presented.

c. It should be mentioned that there were violations of the NH water quality standards for pH at station V-TR (pH = 8.04).

d. It would be helpful to show the location of the Vermont Yankee discharge on Figure 3.5-7 on page 3-30.

e. On page 3-32 it is stated that minor stratification may be occurring at station V-01. Profiles of DO and temperature with depth should be provided to support any conclusions. DES considers a surface water stratified when there is a defined thermocline showing greater than a 1 degree (Celcius) change per meter.

f. To determine if the data is representative of near worse case conditions (i.e., when parameters such as temperature, DO and algal activity are likely to be highest), this section should indicate what the flow was in the river and bypass channel prior to and during sampling. A comparison of the flow to the 7Q10 low flow should also be included in the discussion. Plots showing the flow and sampling results with time would be helpful.

g. To facilitate data analysis, DES requests that the data be uploaded in the DES Environmental database.

C12. Section 3.5.7 Project Effects on Seasonal Variation of Water Quality

a. On page 3.5.7 it is stated that the "... existing and newly collected water quality data indicate the Project has, and will continue to have, no significant impact on the primary water quality of concern, DO, or on other physical or chemical parameters. DES does not believe that the information provided in the PAD supports such a broad-sweeping conclusion and should be deleted or modified. As previously discussed (see comment C11 above), it is not known if the data was collected under worse case conditions. This statement also does not appear to consider the potential impact of Project operations on sediment (and associated nutrient) loadings associated with erosion. Temperature was also relatively high in the impoundment (maximum of 29.33 degrees C at station V-01 per Table 3-5.6, (although part of this could be due to thermal discharges from Vermont Yankee).

C13. Section 3.6.2 Summary of Existing Conditions - Fish Assemblage and Habitat Assessment of the Upper Connecticut River

a. Figure 3.6-1 on pages 3-69 and 3-70, shows Index of Biological Integrity (IBI) results for the Project area based on sampling conducted in 2008 (and reported by Yoder et. al. in 2009) . Results were analyzed using three indices: the Atlantic Slope IBI, the Interim Maine Rivers IBI and the Modified Index of Well-Being. Two of the indices (Interim Maine Rivers IBI and the

Modified Index of Well-Being) showed lower values just upstream of the dam. Moving further upstream, however, the values increase and then decrease again near the upstream portions of the project. No explanation is provided for this behavior. For example, what is the impact of impoundment fluctuations on the results? Also, what is considered a good and poor IBI score? If available, this information should be included in the discussion.

C14. Section 3.6.2 Summary of Existing Conditions - Connecticut River Fish Tissue Contaminant Study

a. This section discusses the result of the Hellyer (2006) Connecticut River Fish Tissue Contaminant Study. Page 3-73 provides a general discussion on total mercury concentrations found in smallmouth bass, white sucker and yellow perch. Graphs and or tables showing actual results in each reach and river mile (with dam locations indicated) should be provided to allow the reader to quantify terms used in this section such as "generally similar" and "higher than".

b. This section (or perhaps a new section) should also discuss the potential impacts of impoundment fluctuations due to Project operations on methylmercury formation (the bioavailable form) and how this can result in increased mercury concentrations in fish and other organisms.

C15. Section 3.6.6 Aquatic Habitat

a. Figure 3.6-6 on page 3-97 shows Qualitative Habitat Evaluation Index (QHEI) scores for various reaches of the Connecticut River. The discussion on page 3-96 states that the QHEI has been shown to correspond predictably with key attributes of fish assemblage quality however, no indication is given of what is considered a good or bad QHEI score. This information should be provided.

b. The discussion on page 3-97 states that an exceptionally high QHEI score was obtained at 5.2 miles downstream of the Vernon dam. This result is not what one would expect for an impounded section of river (on page 3-17 it is stated the upper reaches of the Turners Falls reservoir extend to the base of the Vernon Dam). How was it determined that the river below the Vernon dam is impounded?

C16. Section 3.6.7 Mussels and Macroinvertebrates

a. On page 3-98 it is stated that the dwarf wedgemussel is a federal and state endangered species and that none were found in the Project area. This section should include a discussion of how Project operations may be impacting the dwarf wedgemussels and what could be done to increase the population of this endangered species.

b. The discussion on macroinvertebrates begins on page 3-100. It is stated that two macroinvertebrate stations were sampled downstream of the Vernon dam, one less than one mile downstream of the dam and the other about 5 miles below the dam. However, because the downstream stations are outside of the Project affected area, this data was not included in this review. DES requests that this information be included as the Project likely impacts these locations and, as previously mentioned, the extent of the Turners Falls impoundment is questionable (see comment C15 above).

c. Table 3.6-11 on page 3-101 shows the abundance of macroinvertebrates found on Hester-Dendy Multiplate samplers in the lowest section of the Vernon impoundment in 2002. A discussion of what the results mean should be provided.

d. Similarly a discussion should be provided of what the results shown in Table 3.6-12 on page 3-105 (composition of macroinvertebrates collected less than one mile downstream of the Project dam) mean.

e On page 3-107 it is stated that National Rivers and Streams Assessment (NRSA) collected baseline benthic macroinvertebrate at two locations in the Project impoundment in 2008 and 2009; Station FW08NH016 in Hinsdale (6 miles upstream of the Vernon dam) and Station FB08NH007 in Walpole (23 miles upstream of the dam). It is further reported that EPA will develop indices to rate the condition of each site as good, fair or poor and that the final report is due out by the end of 2012. Please note that based on preliminary results provided by EPA, it is our understanding that both sites will be rated as poor.

C17. Section 3.6.8 Project Effects (regarding Fish and Aquatic Resources)

a. On page 3-110 it is stated that threats to mussel species and macroinvertebrates include stranding from water level fluctuations, sedimentation, and erosion. DES concurs that these impacts are or are likely to be occurring. The next sentence states that because no changes are proposed to Project operations, no new effects on aquatic resources are anticipated. There should be a discussion on what can be done to improve aquatic conditions for species, including, but not limited to, the endangered dwarf wedgemussel.

C18. Section 3.7.3 Plant and Animal Species

a. Table 3.7-5 on page 3-134 (invasive plant species) should include invasive alga *Didymosphenia geminata* (freshwater planktonic alga) and invasive aquatic macrophyte *Najas minor* (submersed). In should also include *Trapa natans*, which were documented in low abundance above the Vernon Dam in August 2012. The plants were hand removed but caltrops may have been dropped before the plant was removed, so this is currently a "watch" species above the dam.

C19. Section 3.7.4 Project Status (regarding Wildlife and Botanical Resources)

a. On page 3-136 it is stated that potential effects of the Project to wildlife and botantical resources can occur as a result of hydroelectric operations. The daily water level fluctuations of approximately 2 vertical feet and associated daily wetting and drying cycles along the river's will likely adversely impact wetland or water dependent wildlife and plant species. Disturbance resulting at least partially from project operations also creates increased opportunities for invasive plant species to colonize and dominate the shorelines of the project. DES concurs that these impacts are or are likely to be occurring. This section further states that because no changes are proposed to Project operations, no new effects on wildlife and botanical resources are anticipated. Since impacts of Project operations have been acknowledged in the PAD, there should be a discussion on what can be done to improve conditions rather than continuing with the status quo.

C20. Section 3.8.1 Summary of Existing Conditions (regarding Wetlands, Riparian, Littoral and Floodplain Habitat)

a. On page 3-137 it is stated that mapping by the National Wetlands Inventory (NWI) was the primary source for describing the wetland and littoral vegetated habitats for the Project. Actual wetland mapping would provide a more accurate baseline. Are there any plans to perform wetland mapping in the Project area?

C21. Section 3.8.3 Project Status (regarding Wetlands, Riparian, Littoral and Floodplain Habitat)

a. On page 3-143 it is stated that potential effects of the Project on wetland, floodplain, riparian, and littoral resources can occur as a result of hydroelectric operations. The daily water level fluctuation of approximately 2 vertical feet has resulted in a zone of sparse vegetation along most shorelines of the impoundment. Wetland and littoral resources in this zone are limited by the frequent wetting and drying. DES concurs that these impacts are or are likely to be occurring. This section further states that because no changes are proposed to Project operations, no new effects on wetland, floodplain, riparian, and littoral resources are anticipated. Since impacts of Project operations have been acknowledged in the PAD, there should be a discussion on what can be done to improve conditions rather than continuing with the status quo.

C22. Section 3.9.5 Project Status (regarding Rare, Threatened and Endangered Species)

a. On page 3-124 it is stated that potential effects of the Project on RTE species or communities can occur as a result of hydroelectric operations. The normal daily water level fluctuation of approximately 2 feet has resulted in a zone of sparse vegetation along most shorelines of the impoundment. Rare species that use habitats along the impoundment edge may be adversely affected by the daily wetting and drying cycles while others rely on the continual or seasonal flooding and souring to maintain suitable habitat and suspend succession. Project impacts on dwarf wedgemussel can occur as a result of river fragmentation, impoundment and hydroelectric operations. The project impoundment results in a more lentic environment characterized by reduced current speed and complexity, and increased sedimentation, and therefore reduced substrate complexity/increased substrate embeddedness. DES concurs that these impacts are or are likely to be occurring. This section further states that because no changes are proposed to Project operations, no new effects on rare state, or federal listed terrestrial plant species or communities are anticipated. Since impacts of Project operations have been acknowledged in the PAD, there should be a discussion on what can be done to improve conditions rather than continuing with the status quo.

II. Study Requests

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is a Class B surface water. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)].

DES submits the following formal study requests to inform the Clean Water Act § 401 water quality certification process and to ensure that state water quality standards will be met. The Northfield Mountain Pumped Storage and Turners Falls projects impact the Turners Falls impoundment, a portion of which (5.7 miles) is in New Hampshire. These projects are therefore included in some of our study requests. In addition to the study requests provided herein, DES also supports the study requests submitted by the New Hampshire Fish and Game Department on February 27, 2013 for the Turners Falls and Northfield Mountain Projects (FERC Nos. 1889 and 2485).

Study Request 1a: Recreational Survey and Enhancement Study at Wilder Hydroelectric Project (FERC NO. 1892)

Goal and Objective

The goal of this study is to determine if potential impacts from project operations at the Wilder Hydroelectric facility support the goals of the NH Fish and Game Departments' Public Boating Access program and the Vermont and New Hampshire's Water Quality Standards Water Quality Standards for recreational uses, and to identify operational modifications that could be performed to enhance recreational opportunities.

The objectives are to:

Survey recreational users and potential users to identify to what extent existing recreational opportunities are being utilized by the public within the project boundaries and why potential recreational users are not using the resource.

Identify how project operations impact recreational users and how operations could be modified to improve recreational opportunities.

Identify how recreational opportunities in the vicinity of the project could be developed to enhance future recreational opportunities, including, but not limited to, boat access, primitive camping sites, improvement in portage trails, etc.

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)]. This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

The Connecticut River is considered a Class B waters. Vermont Water Quality Standards requires that Class B waters be managed to provide full support for all recreational uses, including swimming and other primary contact forms of recreation and boating, fishing and other recreational uses.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources. Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998); which are relevant to this study request are:

1) New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.

2) New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.

3) New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.

4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest Consideration

The requestor is a state natural resource agency.

Existing Information

The PAD provides information on the existing recreational resources, but does not provide information on how project operations adversely affect recreational opportunities or perception of recreational users utilizing opportunities in the vicinity of the project.

Project Nexus

The project impounds 45 miles of river that would otherwise be free flowing. The project currently operates in a peaking mode, with allowable impoundment fluctuations of up to 5 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (675 cfs), but can increase rapidly during times of power generation. Recreational resources and opportunities can be affected by the operations of the hydropower project. The PAD provides limited information on how project operations affect recreational users and opportunities within the project impoundment and tailrace. The NHFGD requests a study to assess how recreational opportunities are impacted by normal daily/seasonal operation of the project.

Proposed Methodology

The proposed study methodology should include an inventory of all the recreational facilities and

opportunities within the project boundary, and a determination of the number of recreational users utilizing the resources. The study should include a component to survey an equal proportion of recreational users utilizing different activities to determine how project operations affect their recreational use and experience, and identify any safety issues associated with project operations or current recreational facilities. Potential recreational users in the area should be identified to determine why potential recreational users do not use the resource. An analysis of the recreational facilities should be conducted to identify future projects that could improve the recreational resources and/or the need to improve existing recreational facilities or access to the resource.

Level of Cost and Effort

The cost and effort of this study will be moderate, but is important to document the potential impact operations on recreational opportunities. This study will also identify opportunities for future enhancement of recreational resources in the vicinity of the project.

Literature Cited:

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010), Concord, NH.

Study Request 1b: Recreational Survey and Enhancement Study at Bellows Falls Hydroelectric Project (FERC NO. 1855)

Goal and Objective

The goal of this study is to determine if potential impacts from project operations at the Wilder Hydroelectric facility support the goals of the NH Fish and Game Departments' Public Boating Access program and the Vermont and New Hampshire's Water Quality Standards Water Quality Standards for recreational uses, and to identify operational modifications that could be performed to enhance recreational opportunities.

The objectives are to:

Survey recreational users and potential users to identify to what extent existing recreational opportunities are being utilized by the public within the project boundaries and why potential recreational users are not using the resource.

Identify how project operations impact recreational users and how operations could be modified to improve recreational opportunities.

Identify how recreational opportunities in the vicinity of the project could be developed to enhance future recreational opportunities, including, but not limited to, boat access, primitive camping sites, improvement in portage trails, etc.

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)]. This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

The Connecticut River is considered a Class B waters. Vermont Water Quality Standards requires that Class B waters be managed to provide full support for all recreational uses, including swimming and other primary contact forms of recreation and boating, fishing and other recreational uses.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources. Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998); which are relevant to this study request are:

1) New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.

2) New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.

3) New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.

4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest Consideration

The requestor is a state natural resource agency.

Existing Information

The PAD provides information on the existing recreational resources, but does not provide information on how project operations adversely affect recreational opportunities or perception of recreational users utilizing opportunities in the vicinity of the project.

Project Nexus

The project impounds 26 miles of river that would otherwise be free flowing. The project currently operates in a peaking mode, with allowable impoundment fluctuations of up to 3 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1083 cfs), but can increase rapidly during times of power generation. Recreational resources and opportunities can be affected by the operations of the hydropower project. The PAD provides limited information on how project operations affect recreational users and opportunities within the project impoundment and tailrace. The NHFGD requests a study to assess how recreational opportunities are impacted by normal daily/seasonal operation of the project.

Proposed Methodology

The proposed study methodology should include an inventory of all the recreational facilities and

opportunities within the project boundary, and a determination of the number of recreational users utilizing the resources. The study should include a component to survey an equal proportion of recreational users utilizing different activities to determine how project operations affect their recreational use and experience, and identify any safety issues associated with project operations or current recreational facilities. Potential recreational users in the area should be identified to determine why potential recreational users do not use the resource. An analysis of the recreational facilities should be conducted to identify future projects that could improve the recreational resources and/or the need to improve existing recreational facilities or access to the resource.

Level of Cost and Effort

The cost and effort of this study will be moderate, but is important to document the potential impact operations on recreational opportunities. This study will also identify opportunities for future enhancement of recreational resources in the vicinity of the project.

Literature Cited:

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 1c: Recreational Survey and Enhancement Study at Vernon Hydroelectric Project (FERC NO. 1904)

Goal and Objective

The goal of this study is to determine if potential impacts from project operations at the Wilder Hydroelectric facility support the goals of the NH Fish and Game Departments' Public Boating Access program and the Vermont and New Hampshire's Water Quality Standards Water Quality Standards for recreational uses, and to identify operational modifications that could be performed to enhance recreational opportunities.

The objectives are to:

Survey recreational users and potential users to identify to what extent existing recreational opportunities are being utilized by the public within the project boundaries and why potential recreational users are not using the resource.

Identify how project operations impact recreational users and how operations could be modified to improve recreational opportunities.

Identify how recreational opportunities in the vicinity of the project could be developed to enhance future recreational opportunities, including, but not limited to, boat access, primitive camping sites, improvement in portage trails, etc.

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)]. This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

The Connecticut River is considered a Class B waters. Vermont Water Quality Standards requires that Class B waters be managed to provide full support for all recreational uses, including swimming and other primary contact forms of recreation and boating, fishing and other recreational uses.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources. Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998); which are relevant to this study request are:

> 1) New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
>
> 2) New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
>
> 3) New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
>
> 4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest Consideration

The requestor is a state natural resource agency.

Existing Information

The PAD provides information on the existing recreational resources, but does not provide information on how project operations adversely affect recreational opportunities or perception of recreational users utilizing opportunities in the vicinity of the project.

Project Nexus

The project impounds 26 miles of river that would otherwise be free flowing. The project currently operates in a peaking mode, with allowable impoundment fluctuations of up to 8 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1250 cfs), but can increase rapidly during times of power generation. Recreational resources and opportunities can be affected by the operations of the hydropower project. The PAD provides limited information on how project operations affect recreational users and opportunities within the project impoundment and tailrace. The NHFGD requests a study to assess how recreational opportunities are impacted by normal daily/seasonal operation of the project.

Proposed Methodology

The proposed study methodology should include an inventory of all the recreational facilities and

opportunities within the project boundary, and a determination of the number of recreational users utilizing the resources. The study should include a component to survey an equal proportion of recreational users utilizing different activities to determine how project operations affect their recreational use and experience, and identify any safety issues associated with project operations or current recreational facilities. Potential recreational users in the area should be identified to determine why potential recreational users do not use the resource. An analysis of the recreational facilities should be conducted to identify future projects that could improve the recreational resources and/or the need to improve existing recreational facilities or access to the resource.

Level of Cost and Effort

The cost and effort of this study will be moderate, but is important to document the potential impact operations on recreational opportunities. This study will also identify opportunities for future enhancement of recreational resources in the vicinity of the project.

Literature Cited:

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 2: Telemetry Study of Upstream and Downstream Migrating Adult American Shad to Assess Passage Routes, Effectiveness, Delays, and Survival (FERC NOs. 1904, 1889 and 2485)

Goals and Objectives

Assess behavior, approach routes, passage success, survival, and delay by adult American shad as they encounter the projects during both upstream and downstream migrations, under permitted project operations conditions, proposed operational conditions, and study treatment operational conditions at First Light Power's Turners Falls and Northfield Mountain Pumped Storage projects and TransCanada's Vernon Project. There are multiple fishways and issues related to both upstream and downstream passage success at the projects. Some of these issues at the Turners Falls Project are similar to and/or pertain directly to the Northfield Mountain and Vernon projects. Therefore, it is reasonable to address passage issues at all projects in a similar manner.

<u>Telemetry Study</u> - This requested study requires use of radio telemetry using both radio and Passive Integrated Transponder (PIT) tag types to provide information to address multiple upstream and downstream fish passage issues. The following objectives shall be addressed in these studies:

- Assessment of any migration delays resulting from the presence of the dam and peaking flow operations of the Turners Falls Project;
- Determine route selection and behavior of upstream migrating shad at the Turners Falls Project under various spill flow levels (e.g., movement to the dam, attraction to Cabot Station, attraction to Station 1 discharge, movement between locations, delay, timing, etc.). A plan and schedule for dam spill flow releases will need to be developed that provides sufficient periods of spill flow conditions, and various generating levels from Turners #1 Station coupled with Cabot Station generation flows (e.g., treatments will require multiple days of consistent discharge). Evaluated spill flows should include flows between 2,500 – 6,300 cfs, which relate to bypass flows identified as providing spawning opportunities for shortnose sturgeon in the lower bypass reach at the Rock Dam. (Kieffer and Kynard 2012). Sturgeon spawning and upstream shad passage occur concurrently;
- Assess near field, attraction to and entrance efficiency of the Spillway Ladder by shad reaching the dam spillway, under a range of spill conditions;
- Evaluate the internal efficiency of the Turners Falls Spillway Ladder;
- Continue data collection of Cabot Station Ladder and Gatehouse Ladder efficiency, to include rates of approach to fishway entrances, entry into fishways, and passage through them, under different operational conditions that occur in these areas;
- Evaluate modifications to the Cabot and/or Spillway fishways recommended by the Service if they are implemented;
- Assess upstream migration from Turners Falls to the Vernon Dam in relation to Northfield Mountain's pumping and generating operations and Vernon Project peaking generation operations. Typical existing and proposed project operation alterations should be evaluated;
- Assess near field, attraction to and entrance efficiency of the Vernon Dam Ladder;
- Assess internal efficiency of the Vernon Dam Ladder;
- Assess upstream passage past Vermont Yankee's thermal discharge (also located on the

west bank of the river 0.45 mile upstream of fish ladder exit)
- Assess upstream migration from Vernon Dam in relation to the peaking generation operations of the Bellows Falls Project. Typical existing and proposed project operation alterations should be evaluated;
- Determine post-spawn downstream migration route selection, passage efficiency, delays and survival related to the Vernon Project, including evaluation of the impact of the Vermont Yankee heated water discharge plume on downstream passage route, migrant delay/timing, efficiency and survival;
- Assess impacts of Northfield Mountain operations on up- and downstream adult shad migration, including delays, entrainment, and behavioral changes and migration direction shifts under existing and proposed project operations;
- Determine downstream passage route selection, timing/delay, and survival under varied project operational flows into the power canal and spill flows at Turners Falls Dam;
- Determine downstream passage route selection, timing/delay in the canal, Cabot Station fish bypass facility effectiveness, and survival of Cabot-bypassed adult shad that enter the Turners Falls Canal system;
- Compare rates and or measures of delay, movement and survival etc., among project areas or routes utilized (e.g., spill at dam vs. power canal) under the range of permitted and proposed conditions; and
- Utilize available data sets and further analyze raw data (e.g., 2003- 2012 Conte Lab Studies) where possible to address these questions and inform power analyses and experimental design.

Information to address all of these questions would rely on the tagging of upstream migrating adult shad at Holyoke Dam and releasing them to migrate naturally from Holyoke through the Turners Falls and Vernon projects and back downstream after spawning. Additional tagged individuals would likely need to be released farther upstream (Turners Falls Canal, upstream of Turners Falls Dam, and upstream of Vernon Dam), to ensure that enough tagged individuals encounter project dams on both upstream and downstream migrations, that these individuals are exposed to a sufficient range of turbine and operational conditions to test for project effects, and to provide adequate samples sizes for statistically valid data analyses to address the many objectives listed. This study will require two years of field data collection to attempt to account for inter-annual variability in river discharge and water temperatures.

<u>Evaluation of Past Study Data</u>- In addition to collection and analysis of new telemetry data, substantial data has already been collected at Turners Falls from multiple years of passage assessments conducted for First Light by U.S. Geological Survey's Conte Anadromous Fish Research Center (Conte Lab) researchers and there are also data from the 2011 and 2012 full river study conducted by the Conte Lab that address Turners Falls, Northfield Mountain and Vernon project migration and passage questions that have not yet been analyzed. These data include several million records each year from more than 30 radio telemetry receivers deployed between Middletown, CT and Vernon Dam. This data will provide substantial information free from the field data collection costs and therefore should be analyzed as part of this study. This data analysis should be completed in 2013 to help inform the design of subsequent field studies.
Evaluation of Methods to Get Shad Past Cabot Station for Spillway Passage at the Turners Falls Dam – The poor passage efficiency of the Cabot Ladder, the first and most used fishway encountered by shad arriving at the Turners Falls Project, and at the entrance to the Gatehouse Ladder, which all Cabot fishway-passed fish must use, has resulted in very poor overall shad

passage efficiency at the project. An alternative to passing fish at the Cabot Station is to install a fish lift at the dam that would put fish directly into the Turners Falls pool, thereby eliminating problems with the Cabot Fishways, and the Gatehouse Fishway entrance and the variable passage efficiency of the Gatehouse Fishways. For this to be effective, attraction of shad to the Cabot Station discharge and associated delays would need to be overcome. It is possible that spillway flow releases coupled with behavioral measures at Cabot Station that dissuade shad from that tailrace could achieve this end. In order to assess the possibilities, we recommend the following study:

1. A literature search and desk-top assessment of the possible behavioral measures that could be effective in getting shad to pass Cabot Station tailrace and continue upstream to the dam.

2. Based on results of the desk-top assessment, possible evaluation of behavioral measures that are likely to be effective.

3. Field evaluation of the effect of different levels of spill at the dam that would induce fish to move past the Cabot Station into the bypass reach and up to the dam (as noted in objectives).

Besides passage success and delays at passage facilities, these studies would assess the impacts of project operations on migration passage delay, route, timing, injury, mortality, and passage structure attraction, retention, and success. Of particular interest will be fish behavior during periods when flow releases from the project increase from the required minimum flows to peak generation flows and when flows subside from peak generation flows to minimum flows and the operation of NMPS in pumping and generation modes.

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)]. This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

The Connecticut River Atlantic Salmon Commission (CRASC) developed *A Management Plan for American Shad in the Connecticut River* in 1992. Management Objectives in the plan include the following

1. Achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually. (Table 1)

2. Achieve annual passage of 40 to 60% of the spawning run (based on a 5-year running average) at each successive upstream barrier on the Connecticut River mainstem.

3. Maximize outmigrant survival for juvenile and spent adult shad.

The Atlantic States Marine Fisheries Commission, Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management), approved in 2010 includes the following objective:

1. Maximize the number of juvenile recruits emigrating from freshwater stock complexes and recommendations:

Upstream Passage –

1. American shad must be able to locate, enter, and pass the passage facility with little effort and without stress.

2. Where appropriate, improve upstream fish passage effectiveness through operational or structural modifications at impediments to migration.

3. Fish that have ascended the passage facility should be guided/routed to an appropriate area so that they can continue upstream migration, and avoid being swept back downstream below the obstruction.

Downstream Passage –

4. To enhance survival at dams during emigration, evaluate survival of post spawning and juvenile fish passed via each route (e.g., turbines,, spillage, bypass facilities, or a combination of the three) at any given facility, and implement measures to pass fish via the route with the least delay and best survival rate.

Based on the CRASC plan, the New Hampshire Fish and Game Department (NHFGD) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.

2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to American shad movement and migration, the NHFGD's goals are:

1. Minimize current and potential negative project operation effects such as migration delays, false attraction, turbine entrainment, survival of project passage routes, and trashrack impingement that could hinder management goals and objectives.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1) New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2) New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3) New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The requestor is a state natural resource agency.

Existing Information

Passage of adult shad at the Turners Falls fishway complex has been the subject of intense study by the Conte Lab since before 1999. These studies have clearly demonstrated that passage through the existing fishways at Cabot and Spillway is poor (<10% in many years). Passage through the Gatehouse fishway is better, but still rarely exceeds 80%, despite the short length of this ladder. In addition to poor passage for fish entering the ladders, shad that ascend the Cabot Fishway experience extensive delays before entry into the Gatehouse Fishway. Shad that ascend Spillway frequently fall back into the canal and are also subject to these upstream delays. A new entrance to the Gatehouse Fishway installed in 2007 led to dramatic improvements in passage out of the canal (from 5% to over 50% in 2011), but passage still falls well short of management goals. In addition, shad spend considerable time (up to several weeks) attempting to pass. These delays likely influence spawning success and survival. Adult shad, unable to pass Gatehouse, experience similar delays in downstream passage, even after they have stopped trying to pass Gatehouse. Without spill, all outmigrating shad that have passed Gatehouse must enter the canal at the Gatehouse and may be subject to delays exiting the canal.

During the course of these studies a very large dataset has been compiled that could yield useful information for further improving passage of shad out of the canal in both the upstream and downstream directions. A unique feature of these data is a 2-dimensional array covering the canal just downstream of Gatehouse, documenting fine scale movements and occupancy of this zone. These data should be combined with computational fluid dynamics (CFD) and real-time hydraulic data to determine how canal hydraulics influence the ability of shad to locate and enter the fishway, and to identify modifications that are likely to lead to improvements in approach and entry rates. A separate CFD modeling study is requested that includes modeling of the Gatehouse Fishway entrance are at the head of the power canal.

In addition, whole-river shad telemetry studies performed in 2011 and 2012 will likely provide useful information and should be analyzed. These data should allow quantification of delay below Turners Falls, and could help guide studies requested above. Preliminary analyses of data through 2011 have been made available to FirstLight and the resource agencies (Castro-Santos and Haro 2005; Castro-Santos and Haro 2010).

The whole-river studies have also shown that, at least in 2011, most shad that pass Turners Falls rapidly progress upstream to Vernon Dam where extensive delays also occur. Data from the 2012 study were not available at this time, but Dr. Castro-Santos stated similar patterns were noted in the data between the years on the topic of upstream delay (personal communication, Dr. Theodore Castro-Santos). Similarly, concerns relative to the downstream passage of spent shad also remain relative to delays, with existing unpublished USGS telemetry data sets suggesting this is an issue within the Turners Falls canal.

Since the first year of operation of the Turners Falls upstream fishways (1980), the percent passage of American shad annually passed upstream of Turners Falls Dam compared to the number passed at the Holyoke Fish Lift has averaged 3.6% (1980-2012 data). The highest values for this metric has not exceed 11% and are well below the noted CRASC Management Plan target range for this objective noted earlier as 40-60% on a five year running average.

Since the first year of operation of the Vernon Dam upstream fish ladder (1981), the percent passage of American shad annually passed at Vernon compared to the number passed upstream of Turners Falls Dam (Gatehouse counts) has averaged 39.4%, ranging from 0.42% to 116.4% (> 100% due to counting error at one or both facilities, unknown).

Nexus to Project Operations and Effects

Existing project operations (peaking power generation) and limited bypass flows have a direct impact on instream flow and zones of passage (migration corridors). Project flow releases affect passage route selection, entry into fishways, and create delays to upstream migration. Inefficient downstream bypasses can result in migration delays and increased turbine passage. Mortality of adult shad passing through these turbines is expected to be high (Bell and Kynard 1985), additional stresses associated with passage and delay may cause mortality as shad are unable to return to salt water in a timely manner. The project's upstream and downstream passage facilities need to be designed and operated to provide timely and effective upstream and downstream fish passage to meet restoration goals of passage to upstream habitat and maximize post-spawn survival. These factors are all critically important to the success of restoration efforts.

Methodology

Use of radio including passive-integrated transponder (PIT) telemetry is widely accepted as the best method to assess fish migratory behavior and passage success and has been used extensively to assess migration and passage issues at Turners Falls as well as other Connecticut River projects. These studies include one conducted in 2011 and 2012 by the Service and U.S. Geological Survey's Conte Anadromous Fish Research Center, which has provided substantial information related to some of the issues identified here. The requested study will build and expand on the information collected over the past two years.

The study design must specify sample sizes, tag configurations and receiver configurations, to ensure that rates of entry and exit to the tailraces, fishways, downstream bypasses, and the bypassed reach can be calculated with sufficient precision to determine effectiveness of flow and ensonification treatments (separate Study Request). For project assessments at Turners Falls (e.g., Cabot, Spillway and Gatehouse ladder attraction and entry, route selection, operational effects), double tagged (radio and PIT) shad will be required for release from Holyoke Dam. Additional shad must be released directly into the Turners Falls Canal to support assessment of the various operational and structural conditions in effect, to be modified in this period, and proposed conditions within the Turners Falls power canal relative to entrances to the Gatehouse fishway. A related request on CFD modeling in the Cabot Station tailrace, the upper power canal near Gatehouse, and in the area around the entrance of the Spillway Ladder will address related project operational effects that will also address identified objectives in this telemetry request. Shad captured at Holyoke and tagged and release upstream of Turners Falls Dam, or tagged out of Gatehouse Ladder, would help to ensure an adequate sample size for evaluations in the vicinity of NMPS and to the Vernon Dam and the ability to address identified study objectives in those project areas. Additional tagged shad are expected to be required for release upstream of the Vernon Dam, which should ensure adequate sample for a separate study request, where shad spawn upstream of Vernon Dam as well as ensuring there is an adequate number of outmigrating spent adults to address related study objectives for adult outmigrants. The required number of tagged fish to address study objectives may be adjusted accordingly from area to area depending on target numbers (i.e., best information on resultant viable tagged fish and power analyses to detect effects) to account for typical passage rates, survival rates, and handling effects as examples.

Existing information on captured, handled, tagged fish performance (e.g., percent that drop back, unsuitable for tracking) and factors such as timing of tagging and potentially transport, must all be carefully considered to ensure an adequate sample size of healthy (e.g., viable to characterize behavior, survival, etc.) tagged fish is available to address the many questions identified in this request (as supported by a statistical power analysis). Additionally, ensuring adequate downstream adult fish sample sizes (to address project effect questions above) requires close consideration as expected losses of healthy tagged fish during upstream passage, natural mortality rates, and tagging related effects, are expected to reduce sample sizes on downstream passage objectives/questions as the season progresses. The use of single PIT tagged fish can help improve sample sizes, but will be of limited use to answer some of the passage questions we have identified.

Due to environmental variability, two years of study work will be necessary. A large array of stationary monitoring stations (radio and PIT) will be needed to address the issues identified among the project areas. A sufficient level of radio receiver and PIT reader coverage will be required, to provide an appropriate level of resolution, for data analyses, to answer these questions on project operational effects. The study will provide information on a variety of structural and operational aspects of fish migration, relative to route selection, timing, survival, and up and downstream passage attraction, retention, delay, efficiency, survival as some examples at three projects (Turners Falls, NMPS, and Vernon). The use of video monitoring may also be utilized for specific study areas such as the Spillway Ladder, to provide additional information on shad entrance activity, with the understanding of some data limitations associated with this approach (fish identification, water visibility). This study will be coordinated with the proposed study request to evaluate ensonification as a shad behavioral deterrent at the Cabot

Station tailrace which will be an additional treatment of the telemetry study.
In addition to the tagging studies, use of video monitoring of the Spillway Fishway would provide additional overall data on Spillway Fishway efficiency as all shad attempting to pass could be monitored versus just those shad that have been tagged.

Level of Effort/Cost, and Why Alternative Studies will not suffice

The requested study is extensive and will require a substantial effort and cost to capture, PIT tag, and radio tag a sufficient number of shad at Holyoke to release at upstream locations. We are not aware of any other study technique that would provide project specific fish behavior and migration information to adequately assess existing project operations and provide insight in possible alternative operations and measures needed to address observed negative impacts to fish migration success. Video monitoring of the Spillway fishway would add a modest cost to this study.

Due to the fact tagged shad will move throughout the larger five project area, to varying degrees, there will be expected cost savings (e.g., radio tags) to both owner/operators, provided cooperation in study planning and implementation occurs.

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Study Request 3: Evaluation of Timing of Downstream Migratory Movements of American Eels on the Mainstem Connecticut River (FERC NOs. 1892, 1855, and 1904)

Goals and Objectives

The goal of this study is to better understand migration timing of adult, silver-phase American eels as it relates to environmental factors and operations of mainstem hydropower projects on the Connecticut River.

The objectives of this study are:

1. Quantify and characterize the general migratory timing and presence of adult, silverphase American eels in the Connecticut River relative to environmental factors and operations of mainstem river hydroelectric projects

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)]. This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

The Atlantic States Marine Fisheries Commission has developed two documents related to the management of American eel:

> 1. Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.
> 2. Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

Objectives of the management plan include: (1) protect and enhance American eel abundance in all watershed where eel now occur; and (2) where practical, restore American eel to those waters where they had historical abundance but may now be absent by providing access to inland waters for glass eel, elvers, and yellow eel and adequate escapement to the ocean for pre-spawning adult eel.

Addendum II contains specific recommendations for improving upstream and downstream passage of American eel, including requesting that member states and jurisdictions seek special consideration for American eel in the FERC relicensing process.

In addition, the Connecticut River Atlantic Salmon Commission (CRASC) developed A Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin in 2005. The goal of the plan is "to protect and enhance the abundance of the American eel resource to ensure its continued role in the Connecticut River Basin ecosystem…" Management objectives in the plan include the following:

1. Protect and enhance eel populations where they currently exist;
2. Where practical, restore populations to waters where they had historical abundance;
3. Provide effective upstream and downstream fish passage around dams and other barriers within the species' range in the basin; and
4. Comply with all requirements of the Fishery Management Plan of the ASMFC.

Based on these plans, the New Hampshire Fish and Game Department (NHFGD) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to downstream passage of American eel, the NHFGD's goals are:

1. Minimize current and potential negative project operation effects that could hinder management goals and objectives.
2. Minimize project-related sources of downstream passage delay, injury, stress, and mortality in order to maximize the number of silver eels migrating to the spawning grounds.

The American eel is also one of New Hampshire and Vermont's Species of Greatest Conservation Need (SGCN). The status for conservation need in Vermont is listed as high priority (Kart et al. 2005), and the species is listed as "vulnerable" in New Hampshire. As identified in Vermont's Wildlife Action Plan (Kart et al. 2005), threats to the species include the construction of large dams on rivers which obstruct juvenile fish access to critical rearing habitats, as well as mortality associated with passing through hydroelectric facilities' turbines during their outmigration to sea.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1) New Hampshire has a wide range of naturally occurring habitats and healthy,

naturally functioning ecosystems.
2) New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3) New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The requestor is a state natural resource agency.

Existing Information

Data on timing of downstream migratory movements and rates of American eels in the mainstem Connecticut River are sparse and relatively incomplete. Preliminary data on presence of "eelsized" acoustic targets have been collected (Haro et al. 1998) within the Turners Falls Project's Cabot Station forebay that were somewhat confirmed by video monitoring at the Cabot Station downstream fish bypass; however, these were short-term studies, with acoustic monitoring only performed from 17 September to 5 October and video monitoring only conducted between 18 September to 22 October.

Some daily monitoring of the downstream bypass at the Holyoke Dam (canal louver array) was performed in 2004 and 2005 (Kleinschmidt, Inc. 2005, 2006, Normandeau Associates 2007); these studies also were of relatively short duration (spanning from October 5 to November 10 in 2004 and September 9 to November 11 in 2005) and the sampler was only operated at night.

To date, no other directed studies of eel migratory movements have been conducted at any location on the Connecticut River mainstem. This information gap needs to be filled, as it relates directly to when downstream passage and protection measures need to be operated.

We also note that within the past seven years, the United States Fish and Wildlife Service (USFWS) has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005 the USFWS issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability. On September 29, 2011 the USFWS issued a substantial 90-day finding and initiated a 12-month status review. It is our understanding that the USFWS is still accepting new American eel information for the ongoing status review.
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Nexus to Project Operations and Effects

The timing of downstream migration of adult eels is poorly defined for the Connecticut River; therefore the general effects of hydroelectric project operations on eel survival to the ocean are unknown. Although separate study requests have been submitted to address project-specific downstream passage route selection, delays, and mortality of eels, general characteristics of river flow and environmental conditions may have significant relationships with project operation and eel migratory success and survival. For example, eels may tend to move immediately before or during periods of significant precipitation (or consequently river flow); times at which projects may be generating at maximum capacity or spilling, which may (or may not) present a higher passage risk to eels. Conversely, periods of low flow may be associated with a significant proportion of total river flow passing through turbine units, which present additional (or different) passage risk to eels. If discrete conditions which promote eel downstream migration are known, it may be possible to take actions with respect to project operations which reduce or minimize passage risk; i.e., operation of a bypass, reduction of intake approach velocities, directed spillage through a “safe” route, etc. These studies should provide baseline information on river-specific downstream migration to predict when silver-phase eels are expected to be migrating in the mainstem Connecticut River, from which project operations could be modified to minimize passage risks.

The studies are proposed for a single or multiple sites; the results will be relevant to all sites on the Connecticut River mainstem.

Methodology Consistent with Accepted Practice

Quantification of downstream movements of American eels in river systems requires systematic sampling of migrants throughout the migratory season. This can be accomplished with traditional active trapping methods; i.e., fyke or stow net sampling, weirs, or eel racks, but these methods are technically challenging on larger mainstem rivers, due to the scale of flows that need to be sampled, difficulties in operation throughout all flow conditions, and high debris loading during fall flows. Passive monitoring of migrant eels using hydroacoustic methods offers an alternative to active trapping. However, passive monitoring requires verification of potential acoustic targets with some level of active (collection) or visual (traditional optical or acoustic video) sampling. Two potential locations offer opportunities to conduct simultaneous passive and active sampling: the Cabot Station (Turners Falls project) canal/forebay and the Holyoke Dam forebay and canal louver/bypass system. Each location possesses a route of downstream passage which conducts a significant proportion of river flow (Cabot canal and Holyoke forebay or canal), and each has a proximal bypass equipped with a sampler so that fish can be concentrated/collected from the passage route and identified to species. Project operations do influence the relative proportion of flow (and thus numbers of downstream migrant eels) in each passage route, so numbers of eels sampled in each route represent only a proportion of the total number of eels migrating downstream within the entire river. Because the absolute proportion of eels using a specific route at any one time is unknown, numbers of eels quantified within a route must serve as a relative index of the degree of migratory movement.

This study shall quantify eel movements in either one, or preferably both, locations for two consecutive years (since environmental conditions strongly influence migratory timing of eels, which can vary significantly from year to year; Haro 2003). Eels will be quantified using methods similar to Haro et al. (1999), by continuously monitoring a fixed location at the projects with hydroacoustics. Because eels tend to concentrate in areas of dominant flow (Brown et al. 2009, EPRI 2001), the zone to be monitored should pass a dominant proportion of project flow throughout most periods of operation (i.e., forebay intake area). Hydroacoustic monitoring shall encompass the entire potential migratory season, beginning in mid-August and ending in mid-December, and shall operate 24 hours per day. Data will be recorded for later processing and archiving.

Systematic active quantification of eels at downstream bypass samplers shall be performed simultaneously with passive hydroacoustic monitoring, to verify presence of eels and relative abundance of eel-sized hydroacoustic targets from the hydroacoustic data. Although daily operation of the bypass sampler could be performed, a more comprehensive technique is to monitor eels entering the bypass with an acoustic camera (i.e. DIDSON, BlueView, etc.). The acoustic camera will afford positive visual identification of eels as they enter the bypass, which is a concentration point for migrating eels. Acoustic camera monitoring will also allow monitoring to be performed 24 hours a day, and will be relatively unaffected by water turbidity (which influences effectiveness of traditional optical video monitoring). The acoustic camera system will be operated during the same time period as acoustic monitoring, and images will be recorded for later processing and archiving.

Data analyses of hydroacoustic, acoustic camera, bypass sampling, and environmental/ operational data will follow standard methodology.

Project operation (flows, levels, gate openings, number of units operating and operation level) and environmental conditions (river flow, temperature, turbidity, air temperature, precipitation) will be monitored regularly (hourly measurements if possible) throughout the duration of the studies.

These methodologies are consistent with accepted practice.

Level of Effort/Cost, and Why Alternative Studies will not suffice

The level of cost and effort for the downstream migrant eel migratory timing study would be moderate, given the level of cost for instrumentation, deployment, and data review/analysis. The applicant did not propose any studies to meet this need in the PAD.

Literature Cited:

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Kleinschmidt, Inc. 2006. Holyoke Project (FERC No. 2004) silver-phased American eel flow priority plan. Submitted to the City of Holyoke Holyoke Gas and Electric Department. 51 pp.

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Study Request 4: Impact of Project Operations on Shad Spawning, Spawning Habitat, and Egg Deposition in the Project Areas of the Turners Falls, Northfield Mountain Pumped Storage and Vernon Project Areas and downstream from Bellow Falls Dam. (FERC Nos. 1855, 1907, 1889, and 2485)

Conduct a field study of spawning by American shad in the Connecticut River mainstem downstream of Turners Falls Dam, in the Turners Falls Dam impoundment, in the Vernon Dam Project area, and downstream of Bellows Falls Dam to determine if project operations (including operations of the Northfield Mountain Pump Storage) negatively impact shad spawning behavior, spawning habitat use, areal extent and quality of those spawning areas, and spawning activity in terms of egg deposition in those areas.

Goals and Objectives

Determine if project operations (under the permitted and proposed operational ranges) affect American shad spawning site use and availability, spawning habitat quantity and quality, and spawning activity in the river reaches downstream from Cabot Station and in the project bypass reach of Turners Falls Dam, in the Turners Falls Dam impoundment and in relation to Northfield Mountain Pump Storage operations, downstream and upstream of the Vernon Dam, and in the project area downstream of Bellows Falls Dam. The following objectives will address this request:

- Determine areas utilized by American shad for spawning by conducting night-time visual observation of spawning activity, identify and define areas geospatially, and obtain data on physical habitat conditions effected by project operations (e.g., water depth, velocity, discharge, substrate, exposure and inundation of habitats);
- Determine project operation effects on observed spawning activity, under a range of permitted or proposed project operation conditions;
- Quantify effects (e.g., water velocity, depths, inundation, exposure of habitats) of project operation on identified spawning areas for a range of conditions, over the complete period of spawning activity;
- Quantify spawning activity as measured by night-time spawning/splash surveys and egg collection in areas of spawning activity, and downstream of these areas, to further determine project operation effects (location extent of exposure from changing water levels and flows and on associated habitats from project operations).

If it is determined that the Project operations are adversely affecting the spawning activity of American shad and impacting spawning area habitat, identify operational regimes that will reduce and minimize impacts spawning habitat and spawning success, within the project area. This study will require two years of field data to capture inter-annual variability to river discharge and water temperatures and to allow for evaluation of alternative flow regimes if year one studies determine that the present peaking regime negatively affects spawning.

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)]. This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

The Connecticut River Atlantic Salmon Commission developed *A Management Plan for American Shad in the Connecticut River* in 1992. Management Objectives in the plan include the following:

1. Achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually.

2. Achieve annual passage of 40% to 60% of the spawning run (based on a 5-year running average) at each successive upstream barrier on the Connecticut River mainstem.

The Atlantic States Marine Fisheries Commission, Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management), approved in 2010 includes the following objective:

1. Maximize the number of juvenile recruits emigrating from freshwater stock complexesand recommendations:
2. To mitigate hydrological changes from dams, consider operational changes such as turbine venting, aerating reservoirs upstream of hydroelectric plants, aerating flows downstream, and adjusting in-stream flows.
3. Natural river discharge should be taken into account when instream flow alterations are being made to a river (flow regulation) because river flow plays an important role in the migration of diadromous fish.
4. Ensure that decisions on river flow allocation (e.g., irrigation, evaporative loss, out of basin water transport, hydroelectric operations) take into account instream flow needs for American shad migration, spawning, and nursery use, and minimize deviation from natural flow regimes.
5. When considering options for restoring alosine habitat, include study of impacts and possible alteration of dam-related operations to enhance river habitat.

The New Hampshire Fish and Game Department (NHFGD) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to American shad, the NHFGD's goals are:

1. Minimize current and potential negative project operation effects on American shad spawning and recruitment.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

> 1) New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
> 2) New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
> 3) New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
> 4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The requestor is a state natural resource agency.

Existing Information

Since the construction of the first fish lift facility at Holyoke Dam in 1967, American shad have had access to spawning and rearing habitat upstream from Holyoke Dam. A number of improvements to the Holyoke fishway have occurred since that time, but while the numbers of shad lifted at Holyoke have reached as much as 721,764 and the overall shad population to the river exceeded 1.6 million shad in 1992 (CRASC 1992), total shad population, and numbers of shad passing Turners Falls and Vernon Dam, have not met CRASC management plan objectives. Population number and passage numbers past Holyoke have declined substantially from those totals in recent years, with average Holyoke passage numbers over the last 10 years of 211,850. Since historically, approximately half of the returning population of shad to the river passed upstream of Holyoke, recent returns are far below management goals. Effective upstream and downstream passage and successful in-river spawning and juvenile production are necessary to help achieve shad management goals for the Connecticut River.

American shad broadcast spawn in congregations over shallow flats and rocky or sandy substrates (Davis et al, 1970, Mansuetti and Kolb 1953), at depths less than 10 feet and often far shallower with spawning fish swimming vigorously near the surface in a closely packed circle (Marcy 1972, Mackenzie et al 1985). Fertilized eggs drift downstream until hatching (Mackenzie et al 1985).

American shad are known to spawn downstream from the Turners Falls Project. Layzer (1974) identified 6 spawning sites from an area below the mouth of the Deerfield River (river mile 191.9) to river mile 161.7 below the Mill River in Hatfield, MA. Kuzmeskus (1977) verified 16 different spawning sites ranging from downstream of the Cabot tailrace to just upstream of the Holyoke dam (river mile 87.1). The only parameter that all spawning sites had in common was current (Kuzmeskus 1977). The NHFGD is not aware of any more recent studies that document whether these 16 sites are still viable spawning locations for shad. We are not aware of any studies that have determined American shad spawning habitat or spawning sites upstream of Vernon Dam to Bellows Fall Dam (historic extent of upstream range).

First Light Power conducted studies in the late spring and summer of 2012, examining habitat conditions downstream of the Turners Falls Dam. The study documented that in low flow conditions, Cabot Station project operations produced fluctuations in water level elevations that can range over 4 feet in magnitude (daily operation) at the USGS Montague Gage Station, to lower values of 2 to 3 feet at the Route 116 Bridge, Sunderland, MA (PAD). Similar short-term, limited monitoring in the upper Turners Falls Dam impoundment identified water level changes due to project operations that cyclically varied several feet on a sub-daily frequency.

Nexus to Project Operations and Effects

American shad are known to spawn at five locations downstream from the Turners Falls Project from an area below the mouth of the Deerfield River (river mile 191.9) and ten other locations downstream to river mile 161.7 below the Mill River in Hatfield (Layzer 1974, Kuzmeskus 1977).

Shad spawning is likely influenced by river flow, which fluctuates greatly due to the project's peaking mode of operation. These fluctuations may impact shad spawning activity by altering current velocities and water depth at the spawning sites. Effects on spawning behavior could include suspension of spawning activity, poor fertilization, flushing of eggs into unsuitable habitat due to higher peaking discharges, eggs dropping out into unsuitable substrate and being covered by sediment deposition, and/or eggs becoming stranded on dewatered shoal areas as peak flows subside.

While a number of shad spawning and egg deposition studies were conducted in the 1970s, that research was aimed at assessing the potential impact of developing a nuclear power station in the Montague Plains section of the Connecticut River. We are not aware of any studies being conducted specifically designed to determine if a relationship exists between spawning behavior, habitat use, and egg deposition and project operations effects of the Turners Falls, Northfield Mountain Pump Storage and Vernon projects and downstream of Bellows Falls Dam.

We are concerned that peaking operations may be altering spawning behavior and contributing to the failure of the Connecticut River shad population to meet CRASC management targets.

Methodology

The first year of study should examine known spawning areas downstream of the Turners Falls Dam project, to determine operation effects on shad spawning behavior, activity, and success. In areas upstream of Turners Falls Dam to the Bellow Falls Dam tailrace, the first year study should identify areas utilized for spawning by American shad. In the second year, should results from year one determine project operations affected spawning activity, access to habitat, or success, downstream of Turners Falls Dam, then an identical more detailed assessment (identified objectives) should be conducted in spawning areas upstream of Turners Falls Dam to the Bellows Falls Dam tailwater. Measures to reduce or eliminate any documented project operation impacts should be explored and evaluated in year two, downstream of Turners Falls Dam. Potential impacts to spawning behavior would best be studied by night-time observations of actual in-river spawning behavior (Ross et al. 1993). Project discharge increases or decreases during actual observed spawning activity will provide empirical evidence of change in behaviors. The observational methodology should follow the protocol specified in Layzer (1974) and/or as described in Ross et al. (1993). The analysis should utilize the observational field data in conjunction with operational data from the projects (station generation and spill on a sub-hourly basis). To assess the impacts of changes in generation flows, the study should include scheduled changes in project operation to ensure that routine generation changes that occur during the nighttime spawning period affect downstream spawning habitats selected for study while shad are spawning. Stier and Crance (1985) provide optimal water velocities during spawning to range between 1 to 3 ft/sec.

In areas used for spawning, the characteristics of those areas (e.g., location, depth, flow, substrate) should be recorded. The effect of project operations (discharge, water velocity, inundation and exposure) should be assessed. Drift nets will be used to collect eggs to quantify egg production before and after flow changes at the spawning site. In the reaches above the Turners Falls dam, night time observations of splashing associated with shad spawning should be performed in each reach as sufficient numbers of shad are passed above each dam. Observations should be performed regularly until the end of the spawning season. The use of radio-tagged adult shad from a separate Study Request will aid in this effort. An estimate of the total area used for spawning and an index of spawning activity should be recorded for each site.

Level of Effort/Cost, and Why Alternative Studies will not suffice

Neither First Light or TransCanada propose any studies to meet this need. Estimated cost for the study is expected to be moderate for each owner, with the majority of costs associated with fieldwork labor.

Literature Cited:

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Stier, D. J. and J. H. Crance. 1985. Habitat suitability index models and instream flow suitability curves: American shad. U. S. Fish and Wildlife Service Biological Report No. 82(10.88), Washington, D.C.

Study Request 5: Bellows Falls Bypass Flow (FERC NO. 1855)

Goals and Objectives

The goal of this study is to determine appropriate bypass flows that will meet State surface water quality standards and protect and enhance the aquatic resources of the Bellows Falls bypass reach.

The objective of the study will be to evaluate the relationship between flow and habitat suitability in the bypass reach.

Relevant Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)]. This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

Specific to aquatic resources within the Bellows Falls bypass reach, the goal is to provide appropriate flows in the bypass reach that meet State surface water quality standards

Pertinent standards for New Hampshire include, but are not limited, to the following:

> Regarding flow, Env-Wq 1703.01(d) states that "unless the flows are caused by naturally occurring conditions, surface water quantity shall be maintained at levels adequate to protect existing and designated uses." Designated uses include aquatic life.
>
> Regarding Biological and Aquatic Community Integrity, Env-Wq 1703.01 states the following:
> (a) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.
> (b) Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.
>
> Regarding dissolved oxygen, Env-Wq 1703. states the following
> (b) Except as naturally occurs, or in waters identified in RSA 485-A:8, III, or subject to (c), below, class B waters shall have a dissolved oxygen content of at least 75% of saturation,

based on a daily average,and an instantaneous minimum dissolved oxygen concentration of at least 5 mg/l.

The New Hampshire Fish and Game Department (NHFGD) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to aquatic resources within the Bellows Falls bypass reach, the NHFGD's goals are:

1. Protect, enhance, or restore, diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Provide appropriate flows in the bypass reach that meets the life history requirements of resident fish and wildlife, including freshwater mussels and other benthic invertebrates.
3. Minimize current and potential negative project operation effects on water quality and aquatic habitat.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1) New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2) New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3) New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The requestor is a state natural resource agency

Background and Existing Information

The Bellows Falls Project bypasses a 3,500 foot-long section of the Connecticut River. Presently this bypass reach only receives flow when inflow exceeds the hydraulic capacity of the Bellow Falls station. According to exceedance curves provided in the PAD, on a monthly basis the bypass reach receives flow the following amount of time:

Month	**% time flow > 11,000 cfs**	**Month**	**% Time Flow >11,000 cfs**
Jan.	15	July	10
Feb.	15	August	8
March	50	Sept.	4
April	90	Oct.	20
May	60	Nov.	35
June	20	Dec.	26

No information exists on the adequacy of the existing bypass flow regime to protect water quality and aquatic life. The bypass reach receives flow less than 30% of the time on an annual basis. While TransCanada did conduct a preliminary water quality study in the summer of 2012 that included water quality in the bypass reach only a summary of the data are provided in the PAD. It does not indicate where the sonde was located, nor the bypass reach conditions during the study period (e.g., What was the flow into the bypass reach during the study? Was the sonde located in the only wetted area of the bypass reach?). Further, the PAD provides no detailed description of the physical or biological characteristics of the bypass reach.

An empirical study is needed to provide information on the relationship between flow and habitat in the bypass reach for use in determining appropriate flows in the bypass reach.

Project Nexus

The Project includes a 3,500-foot-long bypass reach. Absent a mandated discharge at the dam, this habitat would remain dewatered during those times when inflow was within the hydraulic capacity of the units (~70% of the time on an annual basis). The existing license does not require any flow through the bypass reach. The current situation does not sufficiently protect the aquatic resources inhabiting or potentially inhabiting the bypass reach.

The Connecticut River in the project vicinity is dominated by sections that are impounded, backwatered from downstream impoundments or otherwise deep and slow-flowing. In contrast, the Bellows Falls bypass channel is very irregular and diverse, consisting of both coarse substrate of various sizes and in the more downstream segment, jagged, irregular ledge. Given an adequate flow regime, the bypass could provide habitat types that are now rare and therefore of great importance.

Results of the flow study will be used to determine an appropriate flow recommendation that will protect and/or enhance the aquatic resources in the bypass reach for the duration of any new license issued by the Commission.

Proposed methodology

It is requested that a bypass flow study be conducted at the Project. Bypass flow habitat assessments are commonly employed in developing flow release protocols that will reduce impacts or enhance habitat conditions in reaches of river bypassed by hydroelectric projects.

Given the size of the bypass reach (3,500 feet long) and the rareness of the habitat types it contains in this portion of the Connecticut River, we believe a study methodology that utilizes an IFIM approach is appropriate for this site. It is our understanding that this same protocol was used during the relicensing of the Housatonic River Project (FERC No. 2576),[1]and has been accepted by the Commission in other licensing proceedings[2]. Concurrent with the field work, dissolved oxygen/temperature dataloggers should be deployed to determine compliance of tested flows with State water quality standards.

Given the unique channel formation habitat modeling using standard PHABSIM 1 dimensional modeling may not be sufficient to assess the habitat suitability in the bypass reach but rather 2 dimensional, 2D modeling may be needed to better characterize flows and velocities in this reach. We recommend that the approach to habitat modeling be determined during the study plan development stage based on consultations between the applicant and the resource agencies.

Level of effort and cost

The expected level of effort and anticipated costs will be comparable to that experienced on similar FERC relicensing projects of this size.

Field work for flow studies can be reasonably extensive but will depend on consultation with the applicant on study methodology and on-site decisions on locations for data collection and the number of collection locations. Post-fieldwork data analysis would be a moderate cost and effort. Field work associated with this study could be done in conjunction with the Instream Flow Study Request. It is our understanding that the level of effort and costs will be comparable to that experienced on similar FERC relicensing projects (e.g., the Glendale Project, FERC No. 2801).

Literature Cited

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

[1] Housatonic River Project License Application, Volume 4, Appendix F. Connecticut Light and Power Company, August 1999.

[2] Glendale Project (FERC No. 2801) Final Bypass Reach Aquatic Habitat and Instream Flow Study in Glendale Hydroelectric Project Application for Subsequent License (FERC No. 2801), Volume 2, Appendix B, pages 7-8, October 2007.

Study Request 6: Shad Population Model for the Connecticut River (FERC NOs. 1892, 1855, 1904, 1889, and 2485)

Develop an American shad annual step, mathematical simulation population model for the Connecticut River to quantify how project operations and potential restoration/mitigation measures impact the population of shad in the Connecticut River.

Goals and Objectives

The goal of the model is to assess impacts of both upstream and downstream passage at each of the Connecticut River projects and potential management options for increasing returns to the river.

Specific objectives include:

- Annual projections of returns to the Connecticut River;
- A deterministic and stochastic option for model runs
- Life history inputs of Connecticut River shad
- Understanding the effect of upstream and downstream passage delay at projects
- Calibration of the model with existing data
- Analysis of the sensitivity of model inputs
- Analysis of sensitivity to different levels of up- and downstream passage efficiencies at all projects
- Multiple output formats including a spreadsheet with yearly outputs for each input and output parameter

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)]. This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

The Connecticut River Atlantic Salmon Commission (CRASC) developed *A Management Plan for American Shad in the Connecticut River* in 1992. Management Objectives in the plan include the following:

1 Achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually.
2 Achieve annual passage of 40 to 60% of the spawning run (based on a 5-year running average) at each successive upstream barrier on the Connecticut River mainstem.
3 Maximize outmigrant survival for juvenile and spent adult shad.

The New Hampshire Fish and Game Department (NHFGD) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1 Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2 Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to American shad, the NHFGD's goals are:

1 Minimize current and potential negative project operation effects on American shad spawning and recruitment.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1) New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2) New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3) New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The requestor is a state natural resource agency.

Existing Information

Since the construction of the first fish lift facility at Holyoke Dam in 1967, American shad have had access to spawning and rearing habitat upstream from Holyoke Dam. A number of improvements to the Holyoke fishway have occurred since that time, but while the numbers of shad lifted at Holyoke have reached as much as 721,764 and the overall shad population to the river exceeded 1.6 million shad in 1992 (CRASC 1992), total shad populations, and numbers of shad passing Holyoke, Turners Falls and Vernon Dam have not met CRASC management goals. Population and passage numbers past Holyoke have declined substantially from those totals in recent years, with average Holyoke passage numbers since 2000 of 229,876. Whole river population estimates have shown that approximately half of the returning population of shad pass upstream of Holyoke. Recent returns to Holyoke are far below management goals. Average passage efficiency of shad at Turners Falls (Gatehouse counts) and Vernon since 2000 has been 3.1 and 20.4 % respectively. These too are well below the CRASC management goals. Safe, timely and effective up- and downstream passage along with successful spawning and juvenile production are necessary to help achieve shad management goals for the Connecticut River.

Nexus to Project Operations and Effects

Existing project operations and fish ladder efficiencies have a direct effect on shad populations in the Connecticut River. Poor upstream passage efficiencies and delays restrict river access to returning shad. Fish unable to reach upriver spawning grounds may not spawn or have reduced fitness or survival of young. Poor downstream passage survival and downstream passage delays affect outmigration and consequently repeat spawning, an important ecological aspect of the iteroparous Connecticut River shad population (Limberg et al. 2003).

There is concern that poor passage efficiencies and delays at projects may be limiting access to upstream reaches of the river, altering spawning behavior, decreasing outmigration survival and contributing to the failure of the Connecticut River shad population to meet management targets (Castro-Santos and Letcher 2010).

Development of a population model will allow an assessment of individual project impacts on the population as well as the cumulative impacts of multiple projects. The model will allow managers to direct their efforts in the most efficient manner toward remedying the conditions that most impact the shad population.

Methodology

Population models are commonly used to assess anthropomorphic and natural impacts and are consistent with accepted practice. A model similar to this request was constructed for the Susquehanna River by Exelon (FERC #405, RSP 3.4). The model is constructed in Microsoft Access

Specific parameters that would be included in the model:

- Upstream passage efficiency at Holyoke, Turners Falls (Cabot, Gatehouse and Spillway Ladders), Vernon fishways, and any impacts associated with Northfield Mountain.
- Distribution of shad approaching the Turners Falls project between the Cabot Ladder and the spillway at the dam
- Downstream passage efficiencies at Vernon, Northfield Mountain, Turners Falls, and Holyoke projects for juveniles and adults

- Entrainment at Mount Tom and Vermont Yankee
- Sex ratio of returning adults
- The proportion of virgin female adults returning at 4, 5, 6, and 7 years
- The proportion of repeat spawning females at 5, 6 and 7 years
- Spawning success of females in each reach
- Fecundity
- Percent egg deposition
- Fertilization success
- Larval and juvenile in-river survival
- Calibration factor to account for unknown parameters such as at sea survival
- Options for fry stocking and trucking as enhancement measures
- Start year and model run years
- Start population
- Rates of movement to and between barriers
- Temperature, river discharge, and other variable of influence to migration and other life history events

The model should be adaptable to allow the input of new data and other inputs.

Level of Effort/Cost, and Why Alternative Studies will not suffice

Neither First Light nor TransCanada have proposed any study to meet this need. Estimated cost for the study is expected to be low to moderate. As the model describes the impacts of multiple projects and two owners, both project owners would share the cost of model development.

Literature cited:

CRASC (Connecticut River Atlantic Salmon Commission). 1992. A management plan for American shad in the Connecticut River basin. Sunderland, MA

Castro-Santos, T and B. H. Letcher. 2010. Modeling migratory bioenergetics of Connecticut River American shad (*Alosa sapidissima*): implications for the conservation of an iteroparous anadromous fish. Can.J.Fish.Aquat.Sci. 67: 806-830

Limberg, K. E., K. A. Hattala, and A. Kahne. 2003. American shad in its native range. Pages 125-140 in K. E. Limberg and J. R. Waldman, editors. Biodiveristy, status and conservation of the world’s shads. American Fisheries Society, Symposium 35,Bethesda, Maryland

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 7: American Eel Survey Upstream of the Vernon, Bellows Falls, and Wilder Dams (FERC NOs. 1892, 1855, and1904)

Goals and Objectives

The goal of this study is to provide baseline data relative to the presence of American eel upstream of the Vernon, Bellows Falls, and Wilder Dams.

The objective of the study is to determine the relative abundance and distribution of American eel upstream of the Vernon, Bellows Falls and Wilder Dams in both riverine and lacustrine habitat.

Relevant Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)]. This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

The Atlantic States Marine Fisheries Commission has developed two documents related to the management of American eel:

1 Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.
2 Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

Objectives of the management plan include: (1) protect and enhance American eel abundance in all watersheds where eel now occur; and (2) where practical, restore American eel to those waters where they had historical abundance but may now be absent by providing access to inland waters for glass eel, elvers, and yellow eel and adequate escapement to the ocean for prespawning adult eel.

Addendum II contains specific recommendations for improving upstream and downstream passage of American eel, including requesting that member states and jurisdictions seek special consideration for American eel in the FERC relicensing process.

In addition, the Connecticut River Atlantic Salmon Commission (CRASC) developed A Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin in 2005. The goal of the plan is "to protect and enhance the abundance of the American eel resource to ensure its continued role in the Connecticut River Basin ecosystem…" Management objectives in the plan include the following:

1 Protect and enhance eel populations where they currently exist;
2 Where practical, restore populations to waters where they had historical abundance;
3 Provide effective upstream and downstream fish passage around dams and other barriers within the species' range in the basin; and
4 Comply with all requirements of the Fishery Management Plan of the ASMFC.

Based on these plans, the New Hampshire Fish and Game Department (NHFGD) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to American eels, the NHFGD's goals are:

1. Protect, enhance, or restore, diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Understand the baseline condition with respect to the presence of American eel within and upstream of the project area.
3. Minimize current and potential negative project operation effects on American eel inhabiting the project area and/or moving through the area during upstream and downstream migrations

The American eel (*Anguilla rostrata*), is also listed as one of both New Hampshire's and Vermont's Species of Greatest Conservation Need (SGCN). The status for conservation need in Vermont is listed as high priority (Kart et al. 2005), and the species is listed as "vulnerable" in New Hampshire. As identified in Vermont's Wildlife Action Plan (Kart et al. 2005), threats to the species include the construction of large dams on rivers which obstruct juvenile fish access to critical rearing habitats, as well as mortality associated with passing through hydroelectric facilities' turbines during their outmigration to sea.

As outlined in Vermont's Wildlife Action Plan (Kart et al. 2005), research and monitoring needs for this SGCN include determining their distribution and abundance, as the contribution of eels in northern regions to overall stock is unknown. One of the conservation strategies for this species is to support efforts to enhance access of American eels to Vermont waters by minimizing impacts of dams and other obstructions along the Richelieu, St. Lawrence, and Connecticut Rivers.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1) New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2) New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3) New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq*.), the Federal Power Act (16 U.S.C. §791a, *et seq*.), and the Clean Water Act (33 U.S.C. §1251 *et seq*.).

Public Interest

The requestor is a state natural resource agency.

Background and Existing Information

According to the PADs, very few American eels were collected in the Fish Assemblage and Habitat Assessment of the Upper Connecticut River (Yoder et al., 2009). In the Vernon Project area upstream of the dam, only one eel was collected; no eels were collected from the Bellows Falls pool, and none were found upstream of the Wilder Dam. However, in 2012 over 200 eels were documented using the upstream fish ladder at the Vernon Project and the New Hampshire Fish and Game Department has observed eels upstream of the Bellows Falls and Wilder dams. More recently, eels have been observed in Lake Morey, Vermont, which is located upstream of Wilder Dam (Lael Will, VDFW, personal communication). Therefore, while it is clear that some eels are passing all three dams (Vernon, Bellows Falls, and Wilder), it remains unknown how many eels may be rearing in the mainstem habitat upstream of the dams or in tributaries and lakes and ponds that feed into the mainstem river.

No targeted eel surveys have been conducted to determine the abundance and distribution of American eels in riverine and lacustrine habitat upstream of the three projects. This information gap needs to be filled so resource agencies can evaluate properly the need for, and timing of, downstream passage and protection measures for outmigrating silver phase eels.

We also note that within the past seven years, the United States Fish and Wildlife Service (USFWS) has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005 the USFWS issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability. On September 29, 2011 the USFWS issued a substantial 90-day finding and initiated a 12-month status review. It is our understanding that the USFWS is still accepting new American eel information for the ongoing status review.

Project Nexus

The project configurations present problems with respect to providing safe, timely and effective passage for outmigrating eels. The intakes are deep and, while no specification for the trashracks were provided in the PADs, it is unlikely that they would prevent impingement and/or entrainment of eels. Existing anadromous downstream passage facilities at the projects also would not be expected to be effective for eels; the target anadromous species are surfaceoriented, while eels tend to move much deeper in the water column. If eels are utilizing habitat upstream of the dams, then appropriate protection and downstream passage measures will be needed.

In order to understand the need for, and timing of, downstream eel passage at the projects, we are requesting that TransCanada undertake eel surveys in the Connecticut River upstream of the three dams and in tributaries feeding into the mainstem river within the project areas. Surveying tributary habitat is necessary because surveying the mainstem alone may lead to an underestimation of eel abundance, particularly if there are relatively short tributary streams that lead to a lake or pond (where eels may accumulate, leading to true high densities).

Proposed methodology

We request an eel survey be conducted in the mainstem river and tributaries upstream from the three projects. The methodology should be similar to that used in the relicensing of the Saluda Hydroelectric Project, FERC No. 516 (Appendix A), the eel assessment for the Merrimack River completed by the Service's Central New England Fishery Resources Office (Appendix B), and the proposed study plan for the relicensing of the Eastman Falls Project (FERC No. 2457, FERC Accession No. 20121214-512).

In general, a combination of electroshocking (backpack in wadeable rivers and boat-mounted in larger rivers and lakes) and eel pots should be used to collect eels and determine catch rates. Sampled habitat should include: the mainstem Connecticut River from upstream of Vernon Dam to below the Ryegate Dam; tributaries to the Connecticut within that stretch where eels have been collected previously; and lakes and ponds (such as, but not limited to, Spofford Lake and Lake Morey), where eels have been collected previously. Sampling should occur during the summer (July through September).

Level of effort and cost

The expected level of effort and anticipated costs will be comparable to that experienced on similar FERC projects of this size. A study plan recently submitted for the Eastman Falls Project (FERC No. 2457) on the Pemigewasset River in New Hampshire, which is utilizing a similar methodology, estimated that sampling a nine-mile-long impoundment with shocking and eel pots would cost $25,000. They estimated the effort to be two nights for the electrofishing survey. Given the much larger area that will need to be sampled under this request, we estimate moderate cost and effort will be required (20 days of shocking mainstem habitat plus another 5-10 days for tributaries and associated lake/pond habitat).

Literature Cited

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department. Waterbury, Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm. (Accessed September 10, 2012).

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 8: Channel Morphology and Benthic Habitat Impacts at the Vernon, Bellows Falls and Wilder Projects (FERC NOs. 1904, 1855 and 1892)

It is well known that dams interrupt the downstream continuum of sediment supply and transport, which in turn can affect channel morphology and limit the amount of coarse (i.e. gravel/cobble) substrate available for aquatic biota. The Vernon, Bellows Falls and Wilder projects' effects on fluvial processes, channel formation and associated anadromous and riverine fish habitat, as well as aquatic invertebrate habitat, is unclear. This study request aims to provide information on coarse sediment supply and transport as it relates to aquatic benthic habitat (e.g. gravel bars). Results will be used to identify techniques to minimize and/or mitigate impacts to this valuable habitat.

Goals and Objectives

The goal of this study is to understand how the projects affect bedload distribution, particle size and composition as it relates to habitat availability (amount and size of coarse substrate material) for different life-history stages of anadromous (e.g. sea lamprey) and riverine fishes (e.g. walleye), as well as invertebrates (e.g., tiger beetles, mussels- such as the federally-endangered dwarf wedgemussel).

The study objectives include:

> 1. Assess the distribution and extent of the existing substrate types, including gravel and cobble bars within the project affected areas.
>
> 2. Identify the current conditions of the channel and determine the stability of the present substrate/benthic habitat and identify if flow or sediment measures are necessary to improve the aquatic benthic habitat.

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)]. This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the Vermont Fish and Wildlife Department's (VTFWD) mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005). Two of the VTFWD's planning goals are:

> 1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
>
> 2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

> 1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
> 2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
> 3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
> 4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Gravel/cobble habitat is utilized by various riverine fish species during different life history stages and seasons, as it provides sites for spawning, feeding, and refuge (Gore and Shields 1995). Many fish species and aquatic invertebrates (e.g., fresh water mussels, snails, worms, and aquatic insects) live on or near gravel habitat, because it provides a source of food and cover (Miller 1988). Gravel bars also play an important role in water quality, hydrology, and morphology of rivers (Lewis 2005).

As identified in Vermont's Wildlife Action plan (Kart et al. 2005), several state listed mussel species are known to utilize gravel-type substrate. Furthermore, sea lamprey (*Petromyzon marinus*) spawning occurs over substrate composed of a mixture of sand, gravel and rubble. The sea lamprey, within the Connecticut River drainage, is one of New Hampshire and Vermont's Species of Greatest Conservation Need (SGCN). The conservation status of sea lamprey in New Hampshire is listed as "vulnerable." One of the threats identified in Vermont's Wildlife Action Plan (Kart et al. 2005) is degraded spawning habitat, which is second to habitat fragmentation. In support of the VTFWD and the NHFGD's missions, and the Vermont Water Quality Standards, it is important to gain a better understanding of the benthic habitat present in project affected areas and how projects operations may be affecting this habitat.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The requestor is a state natural resource agency.

Existing Information

The PAD generally focuses on erosional impacts due to the projects' operations, but lacks specific information on fluvial geomorphic processes and substrate composition as it relates to impacts to aquatic benthic habitat. Recent studies assessing fluvial geomorphic process and substrate composition in Connecticut River tributaries have documented the impacts of regulated flows from dams on substrate composition, and the possible impacts on the mainstem of the river.

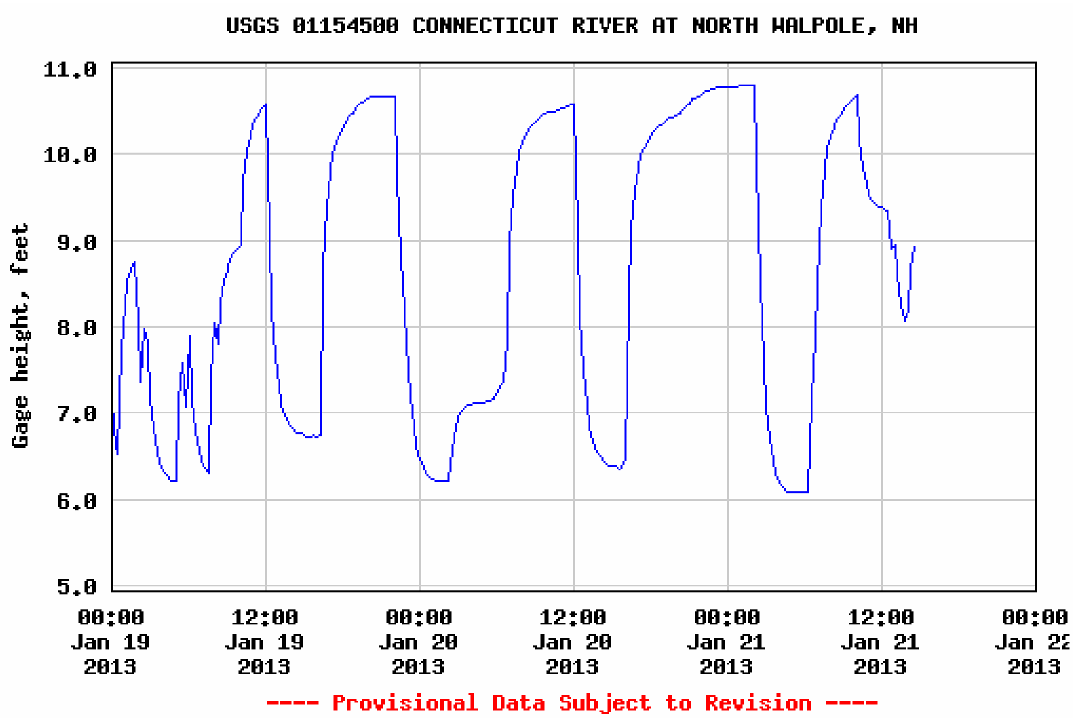
Curtis et al. (2010) utilized a combination of historical aerial photographs, mainstem- and tributary-channel pebble counts, and HEC-RAS flow modeling in the West and White River watersheds (tributaries to the Connecticut River). They documented the time series of postregulation channel narrowing and associated bar growth due to the influx of tributary sediment.
In the West River, Svendsen et al. (2009) quantified changes in channel bed morphology as a result of flow regulation. Utilizing bi-monthly cross-section data from the gauging stations they determined the mean water depth and bed elevation for each cross-section measurement during the pre-dam and post-dam periods. In addition, annual peak stream flow data for each station were used to calculate the flood recurrence, and surface grain distributions at sampling sites upstream and downstream of each tributary confluence using Wolman pebble counts. They found that the sediment load from tributaries are impacting the flow-regulated mainstem West River rather than ameliorating conditions, and that these impacts are reflected in the benthic community structure. These results indicate that environmental flows that mimic the natural hydrograph are needed in regulated reaches of river.

Nexus to Project Operations and Effects

Dams have major impacts on geomorphic processes, ecological function and in turn biotic communities. Changes to substrate composition can significantly affect aquatic life including stability of channel habitats, size distribution and embeddedness of substrate, and decreased habitat diversity and heterogeneity. The projects impound a large portion of the Connecticut River that otherwise would be free flowing and would transport fine sediment downstream leaving larger substrate material (gravel/cobble) exposed to be utilized by aquatic biota. By interrupting the downstream continuum of sediment supply and transport, dams can result in increased bed scour and bank erosion downstream (Kondolf and Matthews 1993). Given the large number of mainstem dams on the Connecticut River, any gravel coming in from tributaries becomes very important to the system. However, many of the tributaries in the project reach have also been dammed. Therefore, there is reason to be concerned about the effects the project dams are having on river processes and physical habitat.

Currently, the projects operate as hydro-peaking facilities as is evident from the USGS stream flow gauge at North Walpole, NH; with large water releases below the dam that increase shear stress on the river bed, substrate is mobilized that otherwise would only be moved during seasonal high flow events. Operations of the existing TransCanada hydroelectric projects likely affect channel morphology and fluvial processes including substrate mobility and particle size distribution. Project-induced changes to natural fluvial processes and channel morphology and substrate composition can have negative impacts on aquatic resources. For example, changes in sediment composition could relocate or decrease important walleye or sea lamprey spawning habitat. In a similar fashion, project-induced changes could make some habitats unsuitable for aquatic invertebrates, including the federally-endangered dwarf wedgemussel. A study is requested to investigate the impacts of project operations on fluvial processes, substrate composition and stability as it relates to aquatic benthic habitat. Results of this study will be used to develop potential license requirements to protect aquatic habitat in the project-affected areas, and may be used to inform other studies that evaluate project effects on related resources. Possible mitigation measures could include gravel augmentation, changes in flow regulation, and instream channel restoration.

An example of the water level fluctuations that occur in Connecticut River due to hydropower generation downstream of the Bellow Falls Project is shown below.



Methodology Consistent with Accepted Practice

Geomorphology studies are generally conducted during hydroelectric relicensing projects to determine channel condition, and substrate composition, and determine whether changes in project operations or sediment measures are necessary and/or whether channel restoration is necessary to improve aquatic benthic habitat.

We recommend a methodology similar to previously approved FERC studies (FERC No. 2246 and 2206). Specific study methods include, but are not limited to, utilizing a combination of historical aerial photographs, pebble counts, and HEC-RAS flow modeling to document and compare temporal changes in morphology and sediment transport dynamics in the project affected areas.

Additional study methods can be found in the FERC Project No. 2246, Yuba County Water Agencies Study Plan Determination: Study 1.1. Lemonds (2006) also conducted an empiricalbased study for the Yadkin-Pee Dee River Hydroelectric Project No. 2206.

Level of Effort/Cost

At a minimum, the study would require a combination of historical aerial photographs, pebble counts, and HEC-RAS flow modeling. Cross-section data from the gauging stations could be used to determine the mean water depth and bed elevation for each cross-section measurement. TransCanada has not proposed any studies to meet this need. Costs would be low to moderate.

Literature Cited:

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Lewis. L. 2005. Arkansas River navigation project mitigation proposal and the Arkansas River conservation initiative. United States Fish and Wildlife Service Concept Paper.

Miller, A. C. 1988. Experimental gravel bar habitat creation in the Tombigbee River Mississippi. U.S. Army Engineer Research and Development Center. Technical Note 07-4.

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Svendsen, K.M., C. E. Renshaw, F. J. Magilligan, K. H. Nislow and J. M. Kaste. 2009. Flow and sediment regimes at tributary junctions on a regulated river: impact on sediment residence time and benthic macroinvertebrate communities. Hydrological Processes. 23: 284–296.

Study Request 9: Downstream American Eel Passage Assessment at Vernon, Bellows Falls, and Wilder (FERC NOs. 1904, 1855, and 1892)

Goals and Objectives

The goal of this study is to determine the impact of three hydroelectric projects on the outmigration of silver eels in the Connecticut River. Entrainment at the conventional turbines at the Vernon, Bellows Falls, and Wilder projects can result in mortality or injury. It is important to understand the passage routes at each project and the potential for delay, injury, and mortality to assess alternative management options to increase survival.

The objectives of this study are:

1. Quantify the movement rates (including delays) and relative proportion of eels passing via various routes at the projects (i.e. through the turbines, through the downstream bypasses; spilled at the dams, etc.).
2. Evaluate instantaneous and latent mortality and injury of eels passed via each potential route.

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)]. This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

The Atlantic States Marine Fisheries Commission has developed two documents related to the management of American eel:

1 Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.
2 Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

Objectives of the management plan include: (1) protect and enhance American eel abundance in all watershed where eel now occur; and (2) where practical, restore American eel to those waters where they had historical abundance but may now be absent by providing access to inland waters for glass eel, elvers, and yellow eel and adequate escapement to the ocean for pre-spawning adult eel.

Addendum II contains specific recommendations for improving upstream and downstream passage of American eel, including requesting that member states and jurisdictions seek special consideration for American eel in the FERC relicensing process.

In addition, the Connecticut River Atlantic Salmon Commission (CRASC) developed A Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin in 2005. The goal of the plan is "to protect and enhance the abundance of the American eel resource to ensure its continued role in the Connecticut River Basin ecosystem…" Management objectives in the plan include the following:

1 Protect and enhance eel populations where they currently exist;
2 Where practical, restore populations to waters where they had historical abundance;
3 Provide effective upstream and downstream fish passage around dams and other barriers within the species' range in the basin; and
4 Comply with all requirements of the Fishery Management Plan of the ASMFC.

Based on these plans, the New Hampshire Fish and Game Department (NHFGD) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1 Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2 Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to downstream passage of American eel, the NHFGD's goals are:
1 Minimize current and potential negative project operation effects that could hinder management goals and objectives.
2 Minimize project-related sources of downstream passage delay, injury, stress, and mortality in order to maximize the number of silver eels migrating to the spawning grounds.

The American eel (*Anguilla rostrata*), is also one of New Hampshire and Vermont's Species of Greatest Conservation Need (SGCN). The status for conservation need in Vermont is listed as high priority (Kart et al. 2005), and the species is listed as "vulnerable" in New Hampshire. As identified in Vermont's Wildlife Action Plan (Kart et al. 2005), threats to the species include the construction of large dams on rivers which obstruct juvenile fish access to critical rearing habitats, as well as mortality associated with passing through hydroelectric facilities' turbines during their outmigration to sea.

As outlined in Vermont's Wildlife Action Plan (Kart et al. 2005), research and monitoring needs for this SGCN include determining their distribution and abundance, as the contribution of eels in northern regions to overall stock is unknown. One of the conservation strategies for this species is to support efforts to enhance access of American eels to Vermont waters by eliminating or minimizing impacts of dams and other obstructions along the Richelieu, St. Lawrence, and Connecticut Rivers.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

> 1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
> 2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
> 3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
> 4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The requestor is a state natural resource agency.

Existing Information

The PAD contains information on the biology and life history of the American eel. It also summarizes eel collection data within the Vernon and Bellows Falls project areas. Eels have been collected both upstream and downstream of the Vernon Project and also have been counted passing the upstream anadromous fish ladder. Eels also have been documented upstream of the Bellows Falls and Wilder projects.

To date, no directed studies of eel entrainment or mortality have been conducted at any of the projects. These information gaps need to be filled so resource agencies can assess the relative and cumulative impact of project operations on outmigrating eels and develop adequate passage and protection measures to meet management goals and objectives.

We also note that within the past seven years, the United States Fish and Wildlife Service (USFWS) has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005 the USFWS issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability. On September 29, 2011 the USFWS issued a substantial 90-day finding and initiated a 12-month status review. It is our understanding that the USFWS is still accepting new American eel information for the ongoing status review.

Nexus to Project Operations and Effects

The Vernon, Bellows Falls, and Wilder projects operate as peaking facilities, except during periods when inflow exceeds the hydraulic capacities of the stations. Silver eels outmigrate during the mid- summer through late fall, a time of year when flows are generally within the operating capacities of the stations. Therefore, the projects would be expected to spill infrequently during the silver eel outmigration.

The project configurations present problems with respect to providing safe, timely and effective passage for outmigrating eels. The intakes likely are deep and, while no specification for the trashracks were provided in the PADs, it is unlikely that they would prevent impingement and/or entrainment of eels. Existing anadromous downstream passage facilities at the projects also would not be expected to be effective for eels; the target anadromous species are surface oriented, while eels tend to move much deeper in the water column. Eels are known to occur upstream of the dams; therefore, it is necessary to understand how eels move through the projects and the level of injury or mortality caused by entrainment through the projects' turbines.

Methodology Consistent with Accepted Practice

In order to understand the movements of outmigrating silver eels as they relate to operations at the Vernon, Bellows Falls, and Wilder projects, radio telemetry technology should be utilized. Radio telemetry is an accepted technology that has been used for a number of studies associated with hydropower projects, including at the Muddy Run Project (FERC No. 2355).

Studies should be designed to investigate route selection (i.e., entrainment vs. spill) independently from estimation of mortality/injury, because these metrics require different telemetric methodologies. Studies also will likely benefit from data collected over both study years (especially route selection studies, which may be more significantly affected by environmental conditions during a given season that mortality/injury studies). It is also envisioned that results from route selection studies can guide design of turbine mortality studies. Therefore, it is proposed, at a minimum, that route selection studies be conducted in multiple years, but mortality/injury studies may be conducted after the first year of route selection studies has been completed.

1. Objective 1: Route Selection

This study will involve systematic releases of radio-tagged silver phase eels at strategic points above areas of interest, to assess general routes of passage (i.e., via spill, bypass, or turbines). Active downstream migrants should be collected within-basin if possible (i. e., Cabot or Holyoke bypass samplers), but fish sourced from out of basin may be acceptable to meet sample size demands. Experimental fish must meet morphometric (e.g. eye diameter relative to body size) criteria to ensure they are migrant silver phase. Collections should be made within the migratory season (late Aug to mid Oct), and eels should be tagged and released within 21 days after capture, but preferably within seven days (particularly if the test eels are from out-of-basin).

All telemetered eels will be radio and passive integrated transponder (PIT) tagged. PIT antennas will be installed at bypasses at Vernon and Bellows Falls and monitored continuously to verify passage of eels via bypass channels.

Vernon Project Route Selection Study:
A minimum number of 50 telemetered eels (e.g., 5 separate groups of approximately 10 eels each) will be required to maximize the data return. Tagged eels should be released at least 5 km upstream of the Vernon project. Groups of eels should be released during spill and non-spill periods if possible. Telemetry receivers and antennas should be located to assess passage via the following potential routes: Vernon spillway; Fishway attraction water intake (if operational); Vernon downstream bypasses; and Vernon Station turbines.

Eels from the Bellows Falls route studies migrating to the Vernon Dam may be used to supplement (but not serve in lieu of) these release groups.

Bellows Falls Dam Route Selection Study:
A minimum number of 50 telemetered eels (e.g., 5 separate groups of approximately 10 eels each) will be required to maximize the data return. Groups of eels should be released during spill (if any) and non-spill and during periods of low, moderate, and high generation conditions, if possible. Tagged eels should be released at least 5 km upstream of the Bellows Falls Dam. If significant spillage occurs during releases, up to 50 additional eels should be released in the upper canal and allowed to volitionally descend through the canal to assure that sufficient number of eels are exposed to canal and powerhouse intake conditions. Telemetry receivers and antennas should be located upstream and downstream of the spillway, at the canal entrance, within the canal, in the fish downstream fish bypass entrance and turbine intakes and in mainstem below Bellows Falls Station to assess passage via the following potential routes: entrainment into the canal; passage over the spillway; into the upstream fishway attraction water intake (this should operated during the study to assess its use by eels as it may be operational in the future for riverine or eel passage as addressed in the Resident Fish Passage study request); the downstream fish bypass; and station turbines.
Eels from the Wilder route study migrating to the Bellow Falls Project may be used to supplement (but not serve in lieu of) these release groups.

Wilder Project Route Selection Study:
A minimum number of 50 telemetered eels (e.g., 5 separate groups of approximately 10 eels each) should be required to maximize the data return. Tagged eels should be released at least 5 km upstream of the Wilder Project. Groups of eels should be released during spill and non-spill periods if possible. Telemetry receivers and antennas should be located to assess passage via the following potential routes: Wilder spillway; Fishway attraction water intake (if operational); Wilder downstream bypasses; and Wilder Station turbines.

Mobile tracking (i.e., via boat) in river reaches between release sites and several km downstream of Vernon Station will be performed at regular intervals during and after releases to confirm routes and fates of passed fish, or fish lost to follow-up. Movement rates (time between release and detection at radio antenna locations, and between radio antenna locations) of eels passing the projects by various routes will also be quantified.

The route selection portion of this study should occur in both study years.

2. Objective 2: Spill, Bypass, and Turbine Mortality/Injury Studies

Spill, bypass, and turbine mortality will be assessed using a radio-telemetric balloon tag method. A minimum number of 50 tagged eels (e.g., 5 separate groups of approximately 10 eels each) will be required at each location (dam spillways, downstream bypasses, and station turbines) to maximize the data return.

For spill mortality sites (dam spillways and downstream bypasses), tagged eels will be injected or released into spill flow at points where water velocity exceeds 10 ft/sec, to minimize the possibility of eels swimming upstream into the headpond or canal. Passed balloon-tagged eels will be recovered below areas of spill and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged eels will be censored from the data.

For turbine mortality sites (Vernon, Bellows Falls, and Wilder stations), tagged eels will be injected into intakes of units operating at or near full generation at points where intake water velocity exceeds 10 ft/sec, to minimize the possibility of eels swimming back upstream through the intakes. Passed balloon-tagged eels will be recovered in the tailrace and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged eels will be censored from the data.

If the balloon tag mortality component of the study occurs in Study Year 1 then all possible route selection sites would need to be evaluated. If the balloon tag mortality component of the study occurs in Study Year 2, then results from the route selection study (Year 1) could be used to inform which sites need to be evaluated for mortality.. Eels recovered from balloon tag studies should not be used for route selection studies.

Data analyses of route selection and turbine mortality (instantaneous and latent) will follow standard methodology.

Project operation (flows, levels, gate openings, number of units operating and operation level) and environmental conditions (river flow, temperature, turbidity, air temperature, precipitation) will be monitored regularly (hourly measurements if possible) throughout the duration of the studies.

These methodologies are consistent with accepted practice.

Level of Effort/Cost

The level of cost and effort for the downstream eel passage study would be moderate to high;

silver eels would need to be collected, tagged, and released in several locations over the course of the migration season. Antennas and receivers would need to be installed at the intakes of all stations as well as at the dam spillways and Station bypasses, and monitored regularly. Data would need to be retrieved periodically, then analyzed. A multi-site route selection study conducted by the USGS Conte Lab on the Shetucket River in Connecticut cost approximately $75,000 for the first year of study.

The applicant did not propose any studies to meet this need in the PAD.

Literature Cited:

Brown, L.S. 2005. Characterizing the downstream passage behavior of silver phase American eels at a small hydroelectric facility. M.Sc. Thesis, Department of Natural Resource Conservation, University of Massachusetts, Amherst, Massachusetts. 110 pp.

Brown, L., A. Haro, and T. Castro-Santos. 2009. Three-dimensional movement of silver-phase American eels in the forebay of a small hydroelectric facility. Pages 277-291in: J. Casselman et al. editors. Eels at the Edge: Science, Status, and Conservation Concerns. American Fisheries Society, Bethesda, MD.

EPRI (Electric Power Research Institute). 2001. Review and documentation of research and technologies on passage and protection of downstream migrating catadromous eels at hydroelectric facilities. EPRI Technical Report No. 1000730, Palo Alto, California 270 pp.

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NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 10: In-stream Flow Habitat Assessment Downstream of Wilder, Bellows Falls, and Vernon Dams (FERC NOs. 1892, 1855, 1904)

Goals and Objectives

The goal of this study is to determine an appropriate flow regime that will protect and enhance the aquatic resources below the Wilder, Bellows Falls, and Vernon projects. Specifically, the objective of this study is to conduct an instream flow habitat study to assess the impacts of the range of proposed project discharges on the wetted area and optimal habitat for key species. The study should include non-steady flow approaches to assess effects of within-day flow fluctuations due to peaking power operations on target fish species and benthic invertebrate communities. Target species will include but are not limited to: American shad, fallfish, white sucker, yellow perch, smallmouth bass, walleye, and dwarf wedge mussel.

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)]. This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

The New Hampshire Fish and Game Department (NHFGD) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

- Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
- Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to aquatic resources, the NHFGD's goals are:

- Protect, enhance, or restore diverse high quality aquatic and riparian habitats for plants,animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
- Provide an instream flow regime that meets the life history requirements of resident and migratory fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The requestor is a state natural resource agency.

Existing Information

The distance from the upstream end of the Wilder impoundment downstream to the Vernon dam is 120 miles. A total of 97 miles (81%) of this segment is impounded. The remaining riverine habitat is within the 17 miles downstream of Wilder dam and the 6 miles downstream of Bellows Falls. At the scoping meetings, FirstLight also indicated that their project assessment may provide evidence that the upstream extent of the Turners Falls impoundment may not reach all the way to Vernon Dam. This would suggest that there may be additional riverine habitat for a presently unknown distance below the Vernon project.

The Wilder, Bellows Falls, and Vernon projects are each operated as daily peaking facilities. Total hydraulic capacity of each facility is 12,700, 11,010, and 12,634 cfs, respectively. Each of the PADs for these projects indicate that "Generation can vary during the course of any day between the required minimum flow and full capacity if higher flows are available" (p. 2-28, p. 2-29, and p. 2-30 in the Wilder, Bellows Falls and Vernon PADs, respectively). Regular daily fluctuations on the order of 9,000 cfs or greater are commonly recorded at USGS gages 01144500 (Connecticut River at West Lebanon, below Wilder Dam) and 01154500 (Connecticut River at North Walpole, NH, below Bellows Falls Dam). Required minimum flows are 675, 1,083, and 1,250 cfs (or inflows if less) for each facility, respectively, though in practice minimum flows are operated as 700, 1300, and 1600 cfs, respectively. The PADs for these projects do not indicate how these minimum flow requirements were established or what specific ecological resources they are intended to benefit. We are not aware of any previously conducted studies that have evaluated the adequacy of this minimum flow in protecting aquatic resources in the 23+ miles of riverine habitat below these projects, nor project effects of daily hydropeaking on riverine habitat. Therefore, in order to fill this important information gap, an empirical study is needed to provide information on the relationship between flow and habitat in the Connecticut River downstream of the Wilder, Bellows Falls, and Vernon projects. Results will be used to determine an appropriate flow recommendation.

Nexus to Project Operations and Effects

The Wilder, Bellows Falls, and Vernon projects are currently operated with a minimum flow release that was not based on biological criteria or field study. Further, the projects generate power in a peaking mode resulting in substantial within-day flow fluctuations between the minimum and project capacity. The large and rapid changes in flow releases from peaking hydropower dams are known to cause adverse effects on downstream habitat and biota (Cushman 1985, Blinn et al. 1995, Freeman et al. 2001). There are at least 23 miles of lotic (flowing) habitat below the project's discharge that are impacted by peaking operations from these projects. This section of the Connecticut River contains habitat that supports native riverine species, including the federally endangered dwarf wedge mussel, and could include spawning and rearing habitat for migratory fish such as American shad. While the existing licenses of the Wilder, Bellows Falls, and Vernon projects do require a continuous minimum flow of 675, 1,083, and 1,250 cfs, respectively, we do not believe this flow sufficiently protects the aquatic resources, including endangered species, of these river reaches, especially in the context of the magnitude, frequency, and duration of changes in habitat that likely occur due to hydropeaking operations.

Results of the flow study will be used to determine an appropriate flow recommendation that will protect and/or enhance the aquatic resources below the Project.

Methodology Consistent with Accepted Practice

In-stream flow habitat assessments are commonly employed in developing operational flow regimes that will reduce the impacts or enhance habitat conditions downstream of hydroelectric projects.

We request that a flow study be conducted in the following areas: in the approximately 17 miles between the Wilder Dam and the headwaters of the Bellows Falls pool, in the approximately 6 miles between the Bellows Falls Dam and the headwaters of the Vernon pool, and in the approximately 1.5 miles between Vernon Dam and the downstream end of Stebbins Island (or the upstream extent of the Turners Pool as determined by FirstLight, whichever river length is greater).

Given the length of river reach (23+ miles) impacted by project operations, we believe a study methodology that utilizes an IFIM approach is appropriate for this context. Similar protocols have been used and accepted by FERC in numerous other licensing proceedings.
The study design should involve collecting wetted perimeter, depth, velocity, and substrate data along transects in the deep, straight-channel areas of the specified river reaches mentioned above. Two-dimensional hydraulic modeling should be conducted in the sections of river with more complex features such as islands, braiding, falls, and shallow-water shoals. The

measurements should be taken over a range of flows sufficient to model the full extent of the operational flow regime. This information should then be synthesized to quantify habitat suitability (using mutually agreed-upon habitat suitability index (HSI) curves) over a range of flows for target species identified by the fisheries agencies. Data should be collected in such a way that allows a dual-flow analysis and habitat time series or similar approaches that will permit assessment of how quality and location of habitat for target species changes over the range of flows that occur as part of the operational flow regime. Dataloggers should be deployed in each reach during the study to continuously measure dissolved oxygen and temperature for comparison to State water quality standards.

Level of Effort/Cost

Field work for instream flow studies can be reasonably extensive but will depend on consultation with the applicant on study methodology and on-site decisions on locations for data collection and the number of collection locations. Use of laser measurements, GPS, and/or an Acoustic Doppler Current Profiler (ADCP, if available) can improve efficiency and accuracy of field measurements. Post-fieldwork data analysis would be a moderate cost and effort. We anticipate that the level of effort and costs will be comparable to that of other FERC relicensing projects of similar size to these projects.

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Study Request 11: Impacts of Water Fluctuations Downstream of the Vernon, Bellows Falls and Wilder Projects on Resident Fish Spawning (FERC NOs. 1904, 1855, 1892)

Goals and Objectives

The goal of this study is to determine if the full range of project induced flow and water level fluctuations in the project-affected areas below the Vernon, Bellows Falls and Wilder Dams negatively impact resident fish spawning (smallmouth bass, common white sucker, walleye and fallfish), and if impacts are found to occur, to develop appropriate mitigation measures.

Specific objectives include:

1) Conduct field studies in the project-affected areas downstream from the Vernon, Bellows Falls and Wilder Dams to assess timing and location of fish spawning. Nesting locations should be mapped.
2) Conduct field studies in the Project affected areas below the Vernon, Bellows Falls and Wilder Dams to evaluate potential impacts of the full range of project induced water level fluctuations on nest abandonment, spawning fish displacement and egg dewatering. The study should also evaluate if changes in fluctuation range would mitigate for identified impacts and/or if other mitigative measures would lessen these impacts.

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)]. This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

A mission of both the New Hampshire Fish and Game Department (NHFGD) and the Vermont Fish and Wildlife Department is to protect and conserve fish and their habitats. Resident fish species are an important component of the river's ecology and in some cases are the basis for a sport fishery. This requested study will help protect and conserve resident fish species by ensuring Project operations do not negatively impact their spawning success.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The requestor is a state natural resource agency.

Existing Information

To our knowledge, no information exists related to this requested study.

Nexus to Project Operations and Effects

Project operations have the potential to impact fish species by influencing spawning success and spawning habitat quality and quantity. For example, flow and water level changes due to Project operations could create conditions where fish eggs are exposed to air, where quality spawning habitat is dewatered, and/or where fish abandon nests containing eggs. A study of a regulated river found temporal fluctuations of streamflow appeared to be the most important abiotic factor determining smallmouth bass nesting success or failure (Lukas and Orth 1995). Similarly, other research suggests stream discharge during and immediately after spawning could be important to smallmouth bass recruitment success (Smith et al. 2005). Current can also impact early survival of walleye by moving eggs and larvae from spawning sites (Humphrey et al. 2012).

Methodology Consistent with Accepted Practice

Common tools to evaluate fish spawning would be used including electrofishing, visual observations, and telemetry. Specific areas of interest are locations in project-affected areas below the Vernon, Bellows Falls and Wilder Dams where it is determined that the before mentioned fish species spawn. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

Level of Effort/Cost

TransCanada does not propose any studies to meet this need. Estimated cost for the study is moderate.

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Study Request 12: Effects of the Wilder and Bellows Falls Projects on the Dwarf Wedgemussel (*Alasmidonta heterodon*) (FERC NOs. 1892 and 1855)

Goals and Objectives

It has been well documented that the damming of rivers can have detrimental impacts on the mussel communities that inhabit areas both upstream and downstream of dams (Watters 1999, Layzer et. al. 1993, Moog 1993). The goal of this study is to evaluate the effects that the Wilder and Bellows Falls hydroelectric projects have on populations of the federally-endangered dwarf wedgemussel (*Alasmidonta heterodon*). In addition, the results of the study can be used to develop measures to minimize adverse impacts to the dwarf wedgemussel in the future. The specific objectives of the study are as follows:

Objective 1: Conduct an initial survey of the free flowing stretch of the Connecticut River from the Wilder Dam to the upstream end of the Bellows Falls impoundment to determine the distribution of the dwarf wedgemussel in this reach.

Objective 2: Determine the best sites for intensive quantitative sampling of mussel communities, with emphasis on the dwarf wedgemussel. Data will be collected to estimate density (mussels per unit area) and age class structure for all species.

Objective 3: Lay the groundwork for a long-term monitoring program.

Objective 4: Document instream behavior of mussels during varying flow conditions.

Objective 5: Determine how availability and persistence of dwarf wedgemussel habitat changes with water level and flow fluctuations.

Relevant Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)]. This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

It is the goal of the U. S. Fish and Wildlife Service (USFWS) to recover the dwarf wedgemussel so that it can be removed from the Endangered Species list in the future. According to the Recovery Plan (USFWS 1993), the Connecticut River dwarf wedgemussel population is one that must be demonstrated to be viable in order before the species can be downlisted to threatened. The Upper Connecticut metapopulation is likely the largest remaining population in the world (USFWS 2007), and so its protection is essential to the recovery of the species as a whole.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The requestor is a state natural resource agency.

Existing Information

In 2011, Biodrawversity, LLC conducted a freshwater mussel survey throughout the Vernon, Bellows Falls, and Wilder project areas (Biodrawversity and LBG 2012). This survey was semi-quantitative (i.e. timed searches were used) and the main goal was to assess the distribution, abundance, demographics, and habitat of the dwarf wedgemussel in the project areas. Dwarf wedgemussel were found in the Wilder impoundment (all within a 14-mile stretch of the river beginning 27 miles upstream of the Wilder Dam) and Bellows Falls impoundment (located sporadically in the upper 17 miles of the impoundment); none were found in the Vernon project-affected area. These results corroborate the results of other studies performed in the past in these areas (Nedeau 2006a, Nedeau 2006b).

Need for additional information

The 2011 survey did not include the 17-mile free flowing stretch of the Connecticut River downstream of Wilder Dam. The dwarf wedgemussel has, in the past, been found within this river reach, although overall there has been limited survey work in the area. A better understanding of the distribution and abundance of the dwarf wedgemussel in this stretch of the river is required before an evaluation of how the dam affects this species can be made. **This need is represented in Objective 1**.

Since the 2011 survey was semi-quantitative, it cannot be used as a basis for determining population estimates or trends (Wicklow 2005). In fact, few if any of the past surveys performed in the project-affected areas have employed quantitative methodology. In addition, there is little quantitative information regarding the age class structure, and therefore recruitment, of the mussel communities in the area. In order to demonstrate that a dwarf wedgemussel population is viable according to the Dwarf Wedgemussel Recovery Plan (USFWS 1993), it must have a large and dense enough population to maintain genetic variability and annual recruitment must be adequate to maintain a stable population. Thus, knowledge of population size and density as well as a better understanding of age class structure is a necessary step in determining the baseline status of dwarf wedgemussel populations. The 2011 survey and other surveys can be used to determine the best sites for implementing a monitoring program. **This need is represented in Objective 2**.

Once this baseline is established, it will be important to monitor the sites so that biologists can estimate and track changes to dwarf wedgemussel populations and/or evaluate any project-related population impacts. Therefore, there is a need to develop long-term monitoring plots that will be surveyed at regular intervals using methodology that is repeatable and yields quantitative, statistically valid results. **This need is represented in Objective 3**.

Flow conditions that result from dam operations may alter the behavior of individual dwarf wedgemussels or individuals of other species. Dam operations affect streamflow, temperature, and dissolved oxygen, and changes to these variables can often be rapid. It is not known how these rapid changes affect various aspects of a mussel's biology, including lure display, shell position (open/closed), siphoning rate, and vertical migration. **This need is represented in Objective 4**.

Dam operations can also affect the availability of habitat for mussels, and this availability can change quickly as water levels fluctuate under peaking operations. The persistence of habitat is a key element to the long-term success of sedentary lotic organisms such as the dwarf wedgemussel (Maloney et. al. 2012), which is unable to quickly move in response to rapid changes in its environment and can thus become stranded in areas of unsuitable habitat; however, there is currently no information concerning the relation of project operations to habitat persistence within the Wilder and Bellows project-affected areas. **This need is represented in Objective 5**.

Project Nexus

The dwarf wedgemussel is known to occur within the Wilder and Bellows Falls project areas and operations of these two dams may affect the viability of this species in the Connecticut River. This study plan will allow for a better understanding of how sub-daily flow and water level fluctuations influence dwarf wedgemussel abundance, available habitat, and behavior. This information can be used to inform the development of license requirements that can ensure the continued existence of this species within the project-affected areas.

Additionally, a long-term monitoring program of important dwarf wedgemussel sites within the project areas is necessary to evaluate any project-related population and/or behavioral impacts that may occur. This information can be used to inform decision makers in the future.

Proposed Methodology

A survey of the 17-mile reach between the Bellows Falls impoundment and the Wilder Dam is the logical first step of the study plan, and this can be done in well less than one field season. This may be treated as an extension of the Biodrawversity and LBG (2012) survey and the same semi-quantitative methodology may be used. Once completed, this survey will help fill in the knowledge gap that exists in the distribution of the dwarf wedgemussel within this reach of the Connecticut River. **This proposed methodology corresponds to Objective 1**.

Next, quantitative study plots should be established at sites throughout the two project affected areas that are known to support the dwarf wedgemussel. Plots should be set up and surveyed using methodology that will allow for the estimation of population density and size. Smith et. al. (2001) have developed such a methodology, which is also outlined in Strayer and Smith (2003). It is based on a double-sampling design (visual inspection of the substrate surface plus excavation of a random subset of quadrats) using 0.25 m2 quadrats that are placed systematically with multiple random starts. This protocol has been used to monitor dwarf wedgemussel populations at two sites on the Ashuelot River in Keene, NH (Nedeau 2004). A number of other recent studies have also made use of this protocol for different species of mussels (Fulton et. al. 2010, Crabtree & Smith 2009, Bradburn 2009).

Data to determine age class structure should also be collected at these selected sites. This would involve measuring the length and estimating the age (through external annuli counts) of each mussel sampled within a quadrat. Based on this information, an analysis of recruitment can be made. This field work and analysis was performed on the mussel community inhabiting the lower Osage River in Missouri as part of the relicensing process of the Osage Hydroelectric Project (FERC no. 459) (ESI 2003). The work done on the Osage can be used as a template for this study. Depending on how many plots are chosen, this phase of the study could take one or two field seasons. **This proposed methodology corresponds to Objective 2**.

The sites surveyed to meet Objective 2 should be resurveyed using the same methodology at regular intervals in the future so that any changes over time and/or over varied flow regimes can be evaluated. In addition, a mark-recapture pilot study should be initiated to evaluate the potential for using this methodology for long-term monitoring of dwarf wedgemussel abundance and survival. Mark-recapture methods provide statistically robust estimates of population parameters that are superior to simple count estimates in cases where it is not practicable to count all individuals in a population. Methods should be similar to those in Peterson et al. (2011), Meador et al. (2011), and Villella et al. (2004), but should focus on differences among sampled sites. Sites should be selected based on those sampled to meet Objective 2, but should also include sites outside of the project area to fully evaluate project effect and to account for any natural variability that may be independent of project effect.

A long-term mussel monitoring program was devised as part of the study plan for the relicensing of the Lake Blackshear Hydroelectric Project (FERC no. 659) on the Flint River in Georgia. According to the monitoring plan (Lake Blackshear Project 2009), three surveys will be conducted five years apart, beginning five years after issuance of the FERC license. Surveys will be quantitative (there is a qualitative aspect to the Lake Blackshear mussel monitoring plan that can be ignored) and will focus on evaluating changes in recruitment and population size of the purple bankclimber (*Elliptoideus sloatianus*), a federally-listed species. A similar protocol should be used to monitor dwarf wedgemussel populations in the project-affected areas of the Connecticut River post-license, although the number of surveys and the time between surveys may require some research and discussion. **This proposed methodology corresponds to Objective 3**.

In order to investigate the effects that the hydropower projects have on mussel behavior, individual mussels should be observed as flow fluctuates as a result of dam operations. Researchers should measure changes in shell position (open/closed), siphoning rate, lure display, horizontal migration (movement across the substrate), and vertical migration (burrowing). Past studies have quantified changes in vertical migration due to flow fluctuations (Saha & Layzer 2008, DiMaio & Corkum 1997). This phase of the study will likely take two field seasons in order to maximize the number of behavioral observations so that any trends can be identified and evaluated. **This proposed methodology corresponds to Objective 4**.

At these same sites, an evaluation of flow fluctuations on dwarf wedgemussel habitat persistence should be conducted following methods similar to those of Maloney et. al. (2012). This will include the development of a two-dimensional hydrodynamic model based on modeled depth, velocity, Froude number, shear velocity, and shear stress. This model will be used to quantify suitable dwarf wedgemussel habitat and its persistence over a range of flows, including flows typically experienced under peaking operations. These methods are being employed to evaluate persistence of dwarf wedgemussel habitat on the Delaware (Maloney et. al. 2012) and Susquehanna (T. Moburg, The Nature Conservancy, personal communication) rivers. Depending on how many plots are chosen, this phase of the study could take one or two field seasons. **This proposed methodology corresponds to Objective 5**.

Level of Effort and Cost

The cost for collecting the data for this study is entirely dependent on the number of study sites selected, as well as how frequently surveys will be conducted as part of the long-term monitoring plan. The expected level of effort and anticipated costs will be comparable to that of similar FERC relicensing projects of this size.

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Study Request 13: Determine the Fish Assemblage in Vernon, Bellows Falls and Wilder Project-Affected Areas (FERC NOs 1904, 1855, 1892)

Goals and Objectives

The goal of this study request is to determine the occurrence, distribution, and relative abundance of fish species present in the project-affected areas of the Vernon, Bellows Falls and Wilder Projects, which potentially includes Species of Greatest Conservation Need (SGCN) for both New Hampshire and Vermont.

Specific objectives include:

1) Document fish species occurrence, distribution and abundance within the project-affected areas along spatial and temporal gradients.

2) Compare historical records of fish species occurrence in the project-affected areas to results of this study.

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)]. This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

A mission of both the New Hampshire Fish and Game Department (NHFGD) and the Vermont ish and Wildlife Department is to protect and conserve fish and their habitats. Riverine fish species are an important component of the river's ecology and are the basis for the sport fishery. Furthermore, several of the states' SGCN have been documented in the project-affected area.

Determining species occurrence, distribution and abundance will help address research and monitoring needs for species whose populations are poorly known. For example, as outlined in Vermont's Wildlife Action Plan (Kart et al.2005), research and monitoring needs for SGCN include monitoring and assessing populations and habitats for current conditions and future changes, and identifying and monitoring problems for species and their habitats.

A study that aims to provide a comprehensive investigation that documents which fish species are utilizing the project-affected areas in relation to spatial, temporal and environmental gradients (i.e. temperature, dissolved oxygen, pH, turbidity) will allow for a fuller understanding and examination of potential impacts that the Vernon, Bellows Falls and Wilder Project's operations have on the species that reside there. As noted below, there is little information concerning riverine fish in the project-affected areas as related to this study request.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The requestor is a state natural resource agency.

Existing Information

A thorough and comprehensive assessment of the fish assemblage present in the project-affected areas of the Bellows Falls and Wilder Projects is lacking. The PAD for the Bellows Falls Project acknowledges that, "Little comprehensive information is available regarding characterization of the fish community in relation to the Project." The PAD for the Wilder Project states, "No targeted studies have been conducted to characterize the fish community in relation to the Project."

The most relevant fish study related to the Bellows Falls and Wilder project-affected areas is a Connecticut River electrofishing survey conducted in 2008 (Yoder et al., 2009). While some sampling was conducted in both project-affected areas during the 2008 survey, this survey did not have the same goals and objectives as those outlined above. Additionally, both the Bellows Falls and Wilder PADs acknowledged that fish species assemblage data are limited and that the synthesized data may not be a full representation of species occurrence in the project-affected areas. Although, fish data has been collected by Vermont Yankee for many years in the Vernon Dam project-affected area, objectives and methodology for those fish surveys differ from those stated here, and gear types were generally limited to boat electrofishing which may not be suitable for properly assessing all species present in the project-affected areas. It is unknown if other species may inhabit or utilize aquatic habitats in the projects area that to this date have not been documented by previous surveys. It follows that without more information on the fish community in the project-affected areas, project impacts on fish species are also unknown.

Nexus to Project Operations and Effects

Project operations have the potential to directly impact fish species life history requirements, biological interactions, and habitat quantity and quality. For example, headpond and tailwater water level fluctuations could dewater important spawning areas or change available habitat, thus limiting productivity of important game fish species by direct impacts to their spawning success or indirectly by limiting the spawning success of forage fish species. Furthermore, several of New Hampshire and Vermont's SGCN have been documented in the project-affected area. Accordingly, a thorough understanding of the current fish assemblage structure and associated metrics are needed in order to examine any potential project-related impacts.

It should be noted that the NHFGD does periodically conduct fish surveys on the Connecticut River in the vicinity of these projects. However, past surveys were not spatially wide spread enough nor conducted in a short enough time frame to meet the goals and objectives of this study request.

Methodology Consistent with Accepted Practice

An accepted and robust field sampling design (e.g., as described in Pollock et al. 2002 or MacKenzie et al. 2006) and accepted methods for collecting fish species likely to be present in the project-affected areas (Bonar et al. 2009) should be used to conduct field surveys. Randomly sampling multiple habitat types using a multi-gear approach will be required to ensure that all fish species present are sampled. The spatial scope of the study will be from the most upstream area influenced by the Wilder Dam to the most downstream area influenced by the Vernon Project. Sampling should occur at each selected site across multiple seasons (spring, summer, and fall). Digital photographs should be taken to avoid misidentifying certain species such as Cyprinids.

The sampling design should include replicate samples for estimation of species detection probability. Sample replicates may be gathered temporally, using different methods, by independent observers, or by randomly sampled spatial replicates (MacKenzie et al. 2006). For each replicate sample, data that may be important for describing variation in species occurrence and presence/absence should be collected and recorded, such as gear type, mesohabitat type, depth, velocity, flow, water temperature, substrate, time of day, day of year, presence of cover, proportion of vegetation cover, size of individuals collected (juveniles may select different habitat), and other factors as determined by a qualified biologist. Species detection, occurrence, and/or abundance as related to these parameters should be estimated using methods as described by Kery et al. (2005) , MacKenzie et al. (2006), Wenger and Freeman (2008), or Zipkin et al. (2010).

Based on first year study results, specific studies examining impacts of project operations on specific fish species may be requested. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

Level of Effort/Cost

The cost of the study will be moderate to high as seasonal sampling with several types of gear will be required. However, cost will also be partially dependent on the number of sites sampled, the number of sample replicates, and the extent of the covariate data that are measured. Provided the collected data are of high quality, analysis and synthesis should take approximately 10-20 days. TransCanada did not propose any studies specifically addressing this issue

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Study Request 14a: Model River Flows and Water Levels Upstream and Downstream from the Wilder, Bellows Falls, Vernon, Turners Falls and Northfield Mountain Pump Storage Stations and Integration of Project Modeling with Downstream Project Operations (FERC NOs. 1904, 1855, 1892, 1889, and 2485).

Goals and Objectives

The goal of this study is to develop river flow models that permit the evaluation of the hydrologic changes to the river caused by the physical presence and operation of the Wilder, Bellows Falls, Vernon, Northfield Mountain and Turners Falls Hydroelectric Projects and the interrelationships between the operation of all five hydroelectric projects up for relicensing and river inflows. Specific objectives of this study include:

1. Conduct quantitative hydrologic modeling of the hydrologic influences and interactions that exist between the water surface elevations of the Wilder, Bellows Falls, and Vernon project impoundments and discharges from the Wilder, Bellows Falls, and Vernon projects and the downstream hydroelectric projects including:
    a. Inflows into the Wilder, Bellows Falls, and Vernon impoundments from the Fifteen Mile Falls Project, FERC No. 2007, and other sources;
    b. Existing and potential discharges from the Wilder, Bellows Falls, and Vernon project generating facilities and spill flows, including existing and potential minimum flow and other operational requirements;
    c. Existing and potential water level fluctuation restrictions (maximum and minimum pond levels) of the Wilder, Bellows Falls, and Vernon impoundments, and consequent changes in downstream project discharges; and
    d. Incorporation of the potential effects of climate-altered flows on project operations over the course of the license.
    e. Comparison of hourly discharge and water surface elevations at various locations at current and proposed operating conditions to model results assuming instantaneous run-of-river at the Projects.
2. Assess how existing and potential operations of the Wilder, Bellows Falls, Vernon, Northfield Mountain and Turners Falls Projects impact one another including:
    a. How Wilder, Bellows Falls, and Vernon flow fluctuations affect pool levels of the Turners Falls impoundment; and
    b. How operations of the Wilder, Bellows Falls, and Vernon projects affect Turners Falls discharges.
    c. How operations at the Turners Falls and Northfield Mountain projects impact flow and water elevations in the Turners Falls impoundment.
    d. Comparison of hourly discharge and water surface elevations at various locations in the Turners Falls impoundment (approximately 5.7 miles of this impoundment is in New Hampshire) at current and proposed operating conditions to model results assuming instantaneous run-of-river at the Projects.

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)].

Regarding flow, Env-Wq 1703.01(d) states that "unless the flows are caused by naturally occurring conditions, surface water quantity shall be maintained at levels adequate to protect existing and designated uses."

Regarding Biological and Aquatic Community Integrity, Env-Wq 1703.01 states the following:

(c) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.

(d) Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met. The Turners Falls and Northfield Mountain Pump Storage Projects are included in this request since their operation impacts the Turners Falls impoundment which extends approximately 5.7 miles into New Hampshire.

This study request is also intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures consistent with the Department's 2010-2015 Strategic Plan that was released in the fall of 2010. The Plan includes two goals and several sub-goals that relate to climate change and shifting environmental conditions in the future. Those goals and sub-goals are as follows:

N.H. Department of Environmental Services Strategic Plan (2010 - 2015)

Goal 1: DES and its partners address climate change through effective mitigation and adaptation strategies and efforts to foster the transition to a clean energy economy.

1.1 DES will work in partnership with other state agencies to institutionalize climate change mitigation and adaptation throughout state operations

1.1.1 DES will consider and integrate climate change mitigation and adaptation across all existing DES program areas. (Target: Commence in 2010, and Ongoing)

1.2 DES will work in partnership with state, regional, and national organizations to integrate and coordinate mitigation and adaptation efforts.

1.2.2 DES will continue to take part in regional and national initiatives to advance the transition to a clean energy economy. (Target: Commence by 2010, and Ongoing)

1.2.3 DES will continue to participate in regional and national initiatives to better prepare for the impacts of climate change. (Target: Commence by 2010, and Ongoing)

1.3 DES will monitor, inventory and report climate change emissions and impacts.

1.3.2 DES will work with state research universities and other institutions and organizations to track the indicators and the impacts of climate change, and to support periodic reporting to policymakers and the public. (Target: Commence in 2010, and Ongoing)

1.4 DES will conduct comprehensive mitigation and adaptation education and outreach.

1.4.3 DES will collaborate with partners to support the provision of resources for technical assistance to communities and organizations that are seeking to incorporate adaptation measures into their projects and plans. (Target: Commence in 2010, and Ongoing)

Goal 2: DES and its partners effectively protect New Hampshire's natural resources and high quality of life as the state grows.

2.1 DES and its partners will strive for efficient land use and development patterns that reduce energy use, support sustainable use and conservation of natural resources, and maintain a viable working landscape.

2.1.4 DES will evaluate the effect of all DES Programs on land use and land development patterns (beginning with the DES Brownfields, Drinking Water, and Wastewater Programs), and modify policies and procedures to encourage efficient use of land and other best development practices. (Target: Commence by 2011, and Ongoing)

2.1.5 DES, in partnership with other organizations, will improve the integration of transportation, environmental, and land-use planning. (Target: Commence in 2011, and Ongoing)

2.2 DES and its partners will work to maintain natural resource functions and promote sustainable use of natural resources.

2.2.1 DES, with its partners, will explore appropriate mechanisms, including market-based approaches, to encourage natural resource conservation, ensure sustainable use of natural resources, promote the use of less impacting alternatives, and reduce the incremental conversion of farm and forest land to developed uses. (Target: Commence in 2011, and Ongoing)

The New Hampshire Fish and Game Department (NHFGD) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to aquatic resources, the NHFGD’s goals are:

1. Protect, enhance, or restore, diverse high quality aquatic and riparian habitats for plants,

animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Provide an instream flow regime that meets the life history requirements of diadromous fish and resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize current and potential negative project operation effects on water quality and aquatic habitat.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The requestor is a state natural resource agency.

Existing Information

Available information in the PAD does not indicate how project operations have altered the hydrology downstream from each of these facilities, which may affect resident and migratory fish, macroinvertebrates, rare, threatened and endangered species, aquatic plants and other biota and natural processes in the Connecticut River. It is also unclear how operations at one facility affect the operations at another and how operations compare to instantaneous run-of-river conditions.

Nexus to Project Operations and Effects

The Wilder, Bellows Falls, and Vernon projects are each currently operated with required minimum flows of 675, 1,083, and 1,250 cfs (or inflows if less) for each facility, respectively, though in practice minimum flows are operated as 700, 1300, and 1600 cfs, respectively. There is presently no required minimum flow for the bypassed reach of the Bellows Falls Project. Each of the projects operates as a daily peaking facility, such that "Generation can vary during the course of any day between the required minimum flow and full capacity if higher flows are available" (p. 2-28, p. 2-29, and p. 2-30 in the Wilder, Bellows Falls and Vernon PADs, respectively). Total hydraulic capacity of each facility is 12,700, 11,010, and 12,634 cfs, respectively. Regular daily fluctuations on the order of 9,000 cfs or greater are commonly recorded at USGS gages 01144500 (Connecticut River at West Lebanon, below Wilder Dam) and 01154500 (Connecticut River at North Walpole, NH, below Bellows Falls Dam). Daily fluctuations in headpond elevation are approximately 2.5' (382' to 384.5' MSL), 1.2' (289.9' to 291.1' MSL), and 1.2' (218.6' to 219.8' MSL) at the Wilder, Bellows Falls, and Vernon impoundments, respectively.

These described changes affect biotic habitat and biota upstream and downstream of each project. Project operations and potential changes to operations to mitigate impacts at each facility are influenced by inflows and operations of upstream projects. Results of river flow analyses will provide necessary information regarding changes that can be made to the Wilder, Bellows Falls, and Vernon Project flow releases and/or water level restrictions, how such changes may be constrained by inflows and upstream project operations, and how these changes potentially affect downstream resources. This information will then be used to develop flow-related license requirements and/or other mitigation measures.

The Turners Falls Project is currently operated with a seasonally-varying minimum bypass flow (400 cfs from 5/1 through 7/15, then 120 cfs through the winter until river temperature rises to ≥ 7°C) and year-round minimum flow below the projects of 1,433 cfs. The project operates as a daily peaking project, often with large, rapid, daily flow fluctuations between the minimum and project capacity (15,928 cfs) and fluctuations in headpond elevation (175' to 186' MSL). These changes affect biotic habitat and biota upstream and downstream of the project. Project operations and potential changes to operations to mitigate impacts are influenced by inflows and operations of upstream peaking projects and the Northfield Mountain Pumped Storage Project operations and potential changes in operations of each project could affect the ability to achieve desired operational changes at other projects.

Results of river flow analyses will then be used to develop flow-related license requirements and/or other mitigation measures that are consistent with State water quality standards.

Methodology Consistent with Accepted Practice

River hydrology statistics and hourly flow modeling are commonly employed at hydroelectric projects to assess implications of project operations on the river environment.

Level of Effort/Cost

Level of effort and cost of model development are expected to be moderate as much of the baseline modeling has already been completed, but running of various scenarios through the model(s) will be needed throughout the relicensing process to assess the implications of changes to the operations of each project on other projects and other resources. The modeling exercise will also require coordination and cooperation between TransCanada and First Light to assure that the model inputs and outputs can be accurately related.

We would anticipate that the expected level of effort and anticipated costs will be comparable to that experienced on similar FERC relicensing projects of this size (e.g., Conowingo, FERC No. 405).

Literature Cited:

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 15a: Impacts of Water Level Fluctuations on Riparian and Aquatic Vegetation, Including Invasive Species, in the Vernon, Bellows Falls and Wilder Project Impoundments and Riverine Reaches (FERC NOs. 1904, 1855, and 1892)

Goals and Objectives

The goal of this study is to determine if the full range of water level fluctuations from the Vernon, Bellows Falls and Wilder Hydroelectric Projects negatively impact emergent aquatic vegetation (EAV) and submerged aquatic vegetation (SAV) and their habitats in the impoundments and riverine reaches below the dams.

The objective is to conduct field studies in mainstem littoral zones, tributaries and backwaters to determine if EAV and SAV species distribution and abundance, and their habitats, are impacted by current water level fluctuations permitted under the TransCanada Projects' licenses and whether aquatic vegetation and its habitats can be enhanced by modifications to project operations or other mitigation measures and whether there is any unique or important shoreline or aquatic habitats that should be protected. Results of this study may also be used to help determine the adequacy of existing downstream minimum flow requirements.

The specific objectives of the field study, at a minimum, include:

The specific objectives of the field study, at a minimum, include:

- Quantitatively describe and map wetland types within 200 feet of the shoreline, and describe associated wildlife;
- Delineate, quantitatively describe, and map all wetland types including invasive species and wildlife observed (e.g., bald eagle nesting, water fowl nesting) within 200 feet of the shoreline, and the extent of this habitat if it extends beyond 200 feet; and
- Quantitatively describe (e.g., substrate composition, vegetation type and abundance) and map shallow water aquatic habitat types subject to project operation inundation and exposure, noting and describing additional areas where water depths at lowest operational range are wetted to a depth less than one foot (flats, near shore areas, gravel bars, with very slight bathymetric change);

A second year of study may be required should river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

The field study should produce a habitat inventory report that includes:

- The results of the field study in the form of maps and descriptions;
- An assessment of project effects on wetland, riparian, littoral zone vegetation and shallow water habitats, invasive plant species, and wildlife habitat at the project; and
- Recommendations for any necessary plant, habitat type, or wildlife, protection and/or invasive species control measures.

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)].

Regarding Biological and Aquatic Community Integrity, Env-Wq 1703.01 states the following:

(e) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.

(f) Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

Aquatic vegetation, such as EAV and SAV, is an important component of the ecology of the Connecticut River. Aquatic vegetation in the areas affected by the project should be studied to demonstrate compliance with Env-Wq 1703.19. This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

A mission of both the New Hampshire Fish and Game Department (NHFGD) and the Vermont Fish and Wildlife Department is to protect and conserve fish and their habitats. Riverine fish species are an important component of the river's ecology and in some cases are the basis for a sport fishery. Aquatic vegetation is crucial fish habitat as the majority of fish in the project impoundments utilize EAV and SAV at some point during their life history. This requested study will help enhance EAV and SAV in the project impoundments.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1. New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2. New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3. New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4. Human activities and land uses are compatible with desired population and recreational

goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

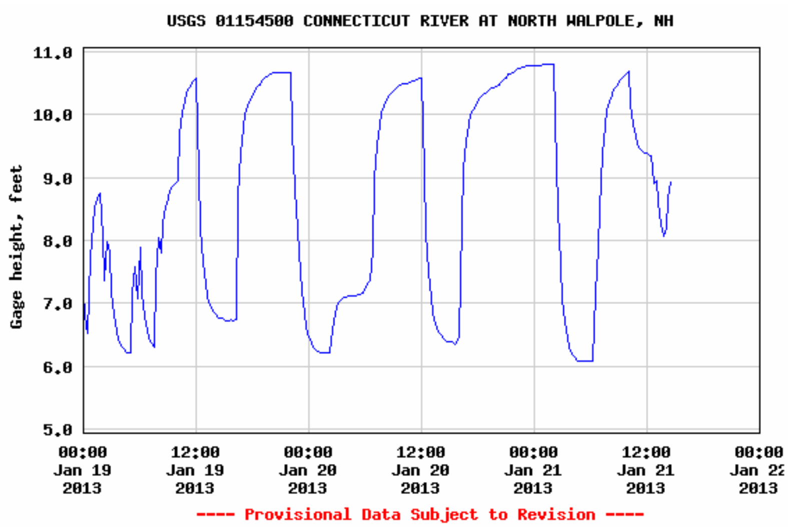
The requestor is a state natural resource agency.

Existing Information

Existing information in the PADs does not quantify EAV and SAV. However, the applicant acknowledges that water level fluctuations caused by the project have the potential to affect fringing wetland and littoral areas:

> "*The average daily water level fluctuation of 2.5 vertical feet has resulted in a zone of sparse vegetation along most of the shorelines of the impoundment. Wetland and littoral resources in this zone are limited by the frequent wetting and drying*." (Wilder PAD, p.3-104, see also similar language in the Bellows Falls PAD p. 3-115 and the Vernon PAD p. 3-143)

An example of the water level fluctuations due to hydropower generation that occur in the Lower Connecticut River downstream of the Bellows Falls Project is shown below.



Nexus to Project Operations and Effects

Water level fluctuations due to project operations have the potential to influence fish species life history requirements, biological interactions, and habitat quantity and quality by impacting EAV and SAV. For example, water level changes due to project operations could create conditions where EAV and SAV abundance is diminished, thus negatively impacting a habitat used by riverine fish for spawning, rearing, feeding, and cover. Additionally, water level fluctuations due to project operations could influence EAV and SAV habitat in the project impoundments and promote invasive plants over native species. This study needs to take into account existing and potential future limits on impoundment level fluctuations intended to limit recreation impacts, and the interactions of any changes in pond level fluctuation range or frequency and discharge changes.

Methodology Consistent with Accepted Practice

Vegetation mapping and mapping of littoral zones in relation to water level fluctuations are common tools for identifying EAV and SAV that may be impacted by changes in water levels. The study should include field surveys designed to describe the characteristics of each mapped wetland, riparian, littoral and shallow water habitat including plant species composition, relative abundance/density, habitat quality, and land use. These surveys should be conducted to describe these habitats at the lowest water level operational range permitted on a daily operation schedule, under low flow conditions. Information collected should include:

- Plant species composition, and their relative abundance/density and condition/structure (e.g., seedlings)
- Surveying for the federally Endangered Northeastern bulrush (*Scirpus ancistrochaetus*);
- Structured data, including estimates of average heights and aerial cover of each vegetation layer (specifically denoting invasive species);
- Aquatic habitat substrate composition, quantity (i.e., percent types and area), wood structure (relative abundance measure applied by area), water depths (inundated, exposed, and water less than one foot);
- Predominate land use(s) associated with each cover type;
- Wildlife sightings should be noted;
- Field verified wetland, riparian, and littoral and shallow water habitats and invasive species occurrences, should be geo-referenced as polygons and overlain on orthophoto at a suitable scale.
- Identification (mapped location, total area) of any EAV, SAV or other fish habitat (i.e. wood, rocks, etc) that is dewatered at the lowest water level operational range permitted on a daily operation schedule, under low flow conditions.

Bathymetric mapping of the littoral zone will be needed to model the extent of this zone that will be affected by different water fluctuation scenarios.

The study area is from the most upstream area influenced by the Wilder Dam to the most downstream area influenced by the Vernon Dam. Water level fluctuations caused by the projects may affect not only the impoundments, but also the downstream river reaches below the dams. Studies would occur in the main river littoral zone and in backwater areas during spring, summer and fall. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

Level of Effort/Cost

Although the PAD's acknowledge that project operations have the potential to impact littoral resources, TransCanada did not propose any studies concerning aquatic vegetation. Analysis as described above is needed to understand potential impacts of the projects on these resources. Estimated cost for the study is moderate due to the need for field assessment.

Literature Cited:

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 15b: Impacts of Water Level Fluctuations due Operations at the Turners Falls and Northfield Mountain Pump Storage Project on Aquatic and Riparian Vegetation, Including Invasive Species, in the Turners Falls Impoundment in New Hampshire (FERC NOs. 1889 and 2485)

Goals and Objectives

The goal of this study is to obtain baseline information on riparian, wetland, emergent and submerged aquatic vegetation, and associated shallow water aquatic habitats (subject to operational inundation and exposure to near exposure) known to occur in the project area. Information would be used to determine whether riparian, wetland, EAV and SAV, littoral, and shallow water (e.g., mid river bars and shoals) habitats are impacted by current water level fluctuations permitted under the Turners Falls and Northfield projects' licenses and whether these vegetation types and shallow water habitats can be protected and restored by modifications to project operations or other mitigation measures. This analysis needs to take into account existing and potential future limits on pond level fluctuations intended to limit recreation impacts, and the interactions of any changes in pond level fluctuation range or frequency and discharge changes under a new licenses of the Turners Falls and upstream projects. This information is needed to determine whether the projects operation affects plants, habitat, and wildlife in the project area, whether aquatic vegetation and its habitats can be enhanced by modifications to project operations or other mitigative measures, and whether there is any unique or important shoreline or aquatic habitats that should be protected.

The specific objectives of the field study, at a minimum, include:

- Quantitatively describe and map wetland types within 200 feet of the shoreline, and describe associated wildlife;
- Delineate, quantitatively describe, and map all wetland types including invasive species and wildlife observed (e.g., bald eagle nesting, water fowl nesting) within 200 feet of the shoreline, and the extent of this habitat if it extends beyond 200 feet; and
- Quantitatively describe (e.g., substrate composition, vegetation type and abundance) and map shallow water aquatic habitat types subject to project operation inundation and exposure, noting and describing additional areas where water depths at lowest operational range are wetted to a depth less than one foot (flats, near shore areas, gravel bars, with very slight bathymetric change);

A second year of study may be required should river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

The field study should produce a habitat inventory report that includes:

- The results of the field study in the form of maps and descriptions;
- An assessment of project effects on wetland, riparian, littoral zone vegetation and shallow water habitats, invasive plant species, and wildlife habitat at the project; and
- Recommendations for any necessary plant, habitat type, or wildlife, protection and/or invasive species control measures.

The New Hampshire Department of Environmental Services (DES) is primarily interested in the portion of the Turners Falls impoundment that is in New Hampshire (estimated to be approximately 5.7 miles in length). It is our understanding that other agencies, such as the United States. Fish and Wildlife Service, are interested in studying the impacts of the Projects in Massachusetts as well.

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)].

Regarding Biological and Aquatic Community Integrity, Env-Wq 1703.01 states the following:

(g) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.

(h) Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

Aquatic vegetation, such as EAV and SAV, is an important component of the ecology of the Connecticut River. Riverine fish species are an important component of the river's ecology and in some cases are the basis for a sport fishery. Aquatic vegetation is crucial fish habitat as the majority of fish in the project impoundment utilize EAV and SAV at some point during their life history. Aquatic vegetation in the areas affected by the project should be studied to demonstrate compliance with Env-Wq 1703.19. This requested study will help enhance EAV and SAV in the project impoundments and downstream.

3. Public Interest

The requestor is a natural resource agency.

Existing Information

Existing information in the PAD does not quantify EAV and SAV in this area, or other shallow aquatic habitat types and physical features (e.g., depths, substrates, wood structure) that are the environment for aquatic biota in the project area. The PAD does provide some limited monitoring data for 2012 (2 locations) on water surface elevations that show daily fluctuations, in the upper third of this impoundment, that varied over 4 feet on a daily cycling frequency, with fluctuations generally in the 2 foot range in low flow months for the data provided in the PAD. The current license does permit a greater pool elevation operational fluctuation, up to a 9 foot change in elevation, based on the Turners

Falls Dam water elevation. In the PAD it is noted these operational fluctuations under most circumstances at the Turners Falls Dam are within 3.5 feet.

In the PAD it is noted that FLP would like to expand its NMPS upper reservoir capacity (by up to 24%), how this may affect project operations and the habitats noted in this request is unknown. It is also noted that water is typically pumped to the upper reservoir in evening and generation back to the river occurs once to twice daily, in daytime hours, based upon power needs and power value. Under current license conditions, provided set thresholds for minimum flow and Turners Dam current license elevations are met, the NMPS may operate with no restriction in timing, frequency, or magnitude for pumping or generation. No data were provided on the operation of the NMPS plant over time relative to data on pumping and generation on an hourly basis, averaged values were provided over monthly periods. It is unclear what the actual timing, frequency and magnitude of these NMPS operations are over the course of a year and how that relates to; aquatic plant species establishment, growth, survival, littoral zone or other shallow water habitat fish spawning periods and their effects on these fishes (reproduction success and subsequent recruitment, e.g., bass and fall fish nests) in available and utilized habitat, and how the quantity and quality of these shallow water habitats are effected by project operational manipulation/alteration, as currently permitted or proposed.

The PAD provides lists of plant and wildlife species whose native ranges overlap with the project area, but it does not provide any baseline information on known occurrences of these species in the wetlands, riparian, littoral and shallow water habitats, within or adjacent to, the project area. Plant and wildlife occurring in these habitats may benefit from protection, mitigation, and enhancement (PMEs) measures, given the potential effects of continuing the current semiautomatic peaking operating regime. In addition, a large scale sediment discharge from NMPS resulted in regulatory actions by FERC, the EPA and MADEP in 2010. Continuing and as yet unresolved management plan measures relative to sediment and NMPS project operations, are further concerns for shallow water, littoral zone, and wetland habitats.

The Atlantic States Marine Fisheries Commission, Atlantic Coast Diadromous Fish Habitat: A Review of utilization, threats, recommendations for conservation, and research needs (ASMFC 2009), contains a review of habitat information for these species. Recommendations in this report include: Maintain water quality and suitable habitat for all life stages of diadromous species in all rivers with populations of diadromous species.

Nexus to Project Operations and Effects

Water level fluctuations due to project operations could affect EAV and SAV habitat as well as the quantity and quality littoral and shallow water habitat. These operational water level fluctuation effects are expected to impact fish species use of these habitats and may affect spawning fishes reproductive success and subsequent population recruitment including but not limited to American shad, blueback herring, sea lamprey, fall fish, and bluegill, which spawn in mid to late spring through early summer in areas subject to daily or more frequent water level fluctuations.

The current operating mode, as well as the unknowns with proposed upper reservoir expansion, may affect wetland riparian, littoral and other shallow water habitats and promote the introduction and expansion of invasive plant species through fluctuating water levels. A study that explains the relationship between the proposed mode of operation and the type and quantity or wetland, riparian, littoral, shallow water habitats, and invasive species affected would help inform a decision on the need for protection and/or control of these resources in the license.

Methodology Consistent with Accepted Practice

The PAD currently contains maps portraying general wetland types from the Cabot Station tailrace upstream to the Vernon Dam. In addition, we understand that the detailed bathymetry exists for the Turners Falls impoundment. The proposed study should utilize this existing information in conjunction with field surveys designed to describe the characteristics of each mapped wetland, riparian, littoral and shallow water habitat including plant species composition, relative abundance/density, habitat quality, and land use. These surveys should be conducted to describe these habitats at the lowest water level operational range permitted on a daily operation schedule, under low flow conditions. Information collected should include:

Plant species composition, and their relative abundance/density and condition/structure (e.g., seedlings);

Structured data, including estimates of average heights and aerial cover of each vegetation layer (specifically denoting invasive species);

Aquatic habitat substrate composition, quantity (i.e., percent types and area), wood structure (relative abundance measure applied by area), water depths (inundated, exposed, and water less than one foot);

Predominate land use(s) associated with each cover type;

Wildlife sightings should be noted;

Field verified wetland, riparian, and littoral and shallow water habitats and invasive species occurrences, should be geo-referenced as polygons and overlain on orthophoto at a suitable scale.

7. Level of Effort/Cost, and Why Alternative Studies will not suffice

In the PAD, First Light identified impacts of the project operations on wetlands, riparian and littoral zone habitat as a potential issue to be addressed in relicensing, and proposed wetland vegetation mapping. However, additional analysis as described above is needed to understand the impacts of the project on these resources and habitats.

A wetlands, riparian, littoral/shallow water, invasive species inventory, of the scope envisioned, would likely require 6-8 months to complete and cost $40,000 to $50,000.

Literature Cited:

Atlantic States Marine Fisheries Commission. 2009. Atlantic coast diadromous fish habitat: A review of utilization, threats, recommendations, for conservation, and research needs. Habitat Management Series #9. Washington, D.C.

Study Request 16: Impacts of the Vernon, Bellows Falls and Wilder Project Impoundment Water Fluctuations on Resident Fish Spawning (FERC NOs. 1904, 1855, 1892)

Goals and Objectives

The goal of this study is to determine if the full range of water level fluctuations in the Vernon, Bellows Falls and Wilder Hydroelectric Projects negatively impact resident fish species (smallmouth bass, largemouth bass, yellow perch, black crappie, common sunfish, bluegill, chain pickerel, northern pike, golden shiner, common white sucker, spottail shiner, walleye and fallfish) in the impoundments, and if impacts are found to occur, to develop appropriate mitigation measures.

Specific objectives include:

1) Conduct field studies in the mainstem, tributaries and backwaters of project affected areas to assess timing and location of fish spawning. Nesting locations should be mapped.

2) Conduct field studies in the mainstem, tributaries and backwaters of project-affected areas to evaluate potential impacts of impoundment fluctuation on spawning habitat, nest abandonment, spawning fish displacement and egg dewatering. The study should also evaluate if changes in impoundment fluctuation range would mitigate for identified impacts and if other mitigative measures would lessen these impacts.

Resource Management Goals

A mission of both the New Hampshire Fish and Game Department (NHFGD) and the Vermont Fish and Wildlife Department is to protect and conserve fish and their habitats. Resident fish species are an important component of the river's ecology and in some cases are the basis for a sport fishery. This requested study will help protect and conserve resident fish species by ensuring project operations do not negatively impact their spawning success.

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)].

Regarding flow, Env-Wq 1703.01(d) states that "unless the flows are caused by naturally occurring conditions, surface water quantity shall be maintained at levels adequate to protect existing and designated uses."

Regarding Biological and Aquatic Community Integrity, Env-Wq 1703.01 states the following:

(i) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.

(j) Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

Resident riverine fish are important components of the ecology of the Connecticut River. Fish populations and habitats in the areas affected by the project should be studied to demonstrate compliance with Env-Wq 1703.19.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.

2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.

3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.

4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

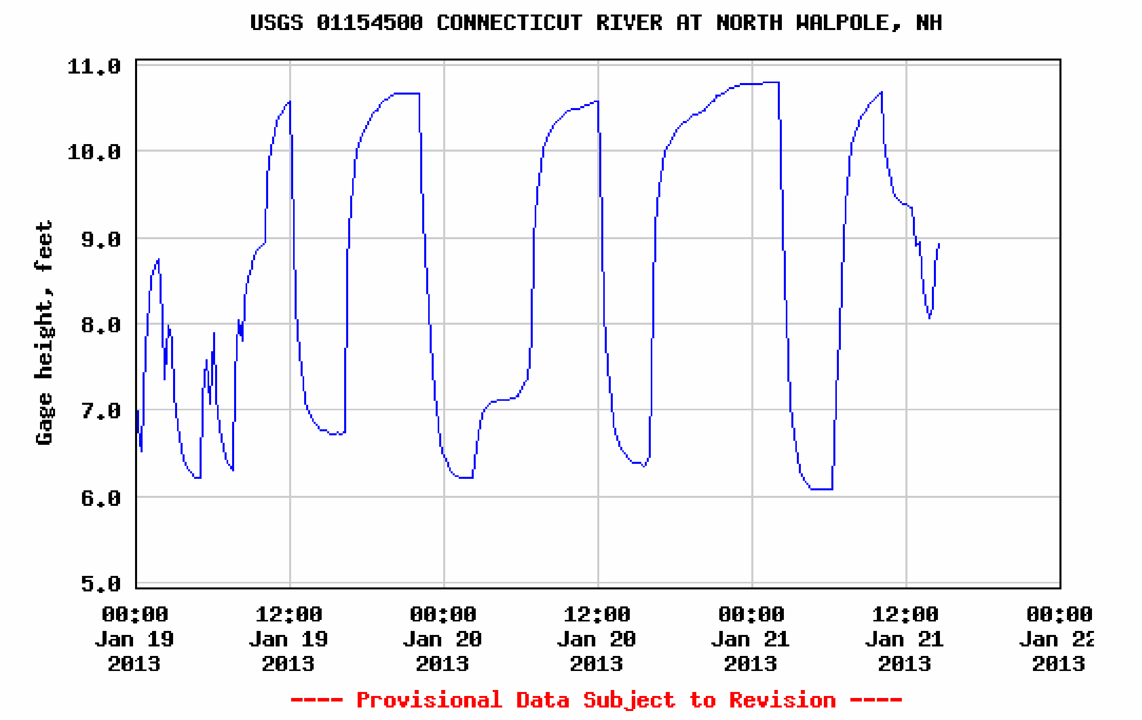
Public Interest

The requestor is a state natural resource agency.

Existing Information

To our knowledge, no information exists related to this requested study.

An example of the water level fluctuations due to hydropower generation that occur in the Lower Connecticut River downstream of the Bellows Falls Project is shown below.



Nexus to Project Operations and Effects

Project operations have the potential to impact fish species by influencing spawning success and spawning habitat quality and quantity. For example, water level changes due to project operations could create conditions where fish eggs are exposed to air, where quality spawning habitat is dewatered, and/or where fish abandon nests containing eggs. The New Hampshire Fish and Game Department has received several calls in past springs regarding "acres" of yellow perch eggs being dewatered in the Bellows Falls Impoundment.

The projects operate within normal, permitted and flood-condition reservoir fluctuation limits that include during high flow events, the dropping of stantion bays that cannot be raised without a subsequent drawdown of the impoundment beyond normal project operating ranges. The full range of reservoir fluctuations, including periodic drawdowns for stantion bay replacement, need to be addressed in this study.

Methodology Consistent with Accepted Practice

Common tools to evaluate fish spawning and habitat would be used including, but not limited, electrofishing, visual observations, telemetry and habitat measurements. The study area for this request includes all impounded waters, including tributaries and backwaters, within the project-affected areas of the Wilder, Bellows Falls and Vernon Hydroelectric Projects. A second year of study may be required if first year data collection is limited due to environmental or other conditions, if river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values), or if river temperatures are atypical during the study period.

Level of Effort/Cost, and Why Alternative Studies will not suffice

TransCanada does not propose any studies to meet this need. Estimated cost for the study is moderate to high but is dependent on the amount of field study that is needed.

Literature Cited:

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 17: Impacts of the Vernon, Bellows Falls and Wilder Project Operations on Tributary and Backwater Area Access and Habitats. (FERC NOs. 1904, 1855, 1892)

Goals and Objectives

One goal of this study is to determine if water level fluctuations from the Vernon, Bellows Falls and Wilder Hydroelectric Projects result in a barrier(s) to fish movement in and out of tributaries and backwaters to the impoundments and riverine reaches below dams.

A second goal is to determine if water level fluctuations in the Vernon, Bellows Falls and Wilder Project impoundments impact water levels, available fish habitat and water quality in tributaries and backwaters to the impoundments and riverine reaches below dams, and if impacts are found, to ascertain how spatially far reaching they are and develop mitigation measures.

Results of this study may also be used to help determine the adequacy of existing downstream minimum flow requirements.

Specific objectives include:

1) Conduct a field study of tributaries and backwaters, including water velocity and habitat data where appropriate, to evaluate potential impacts of impoundment fluctuation on fish access to tributaries and backwater areas. The study should also evaluate if changes in impoundment fluctuation range would mitigate for any identified impacts and if other mitigative measures would improve access.

2) Conduct a field study to examine potential impacts of impoundment fluctuations on water levels, available habitat and water quality in tributaries and backwaters. The evaluation should also evaluate if changes in impoundment fluctuation range would mitigate for identified impacts and if other mitigative measures would lessen these impacts.

Resource Management Goals

A mission of both the New Hampshire Fish and Game Department (NHFGD) and the Vermont Fish and Wildlife Department is to protect and conserve fish and their habitats. Diadromous and resident riverine fish species are an important component of the river's ecology and in some cases are the basis for a sport fishery. Furthermore, two of the states' Species of Greatest Conservation Need (SGCN) that would potentially be impacted have been documented in the project-affected areas.

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)].

Regarding flow, Env-Wq 1703.01(d) states that "unless the flows are caused by naturally occurring conditions, surface water quantity shall be maintained at levels adequate to protect existing and designated uses."

Regarding Biological and Aquatic Community Integrity, Env-Wq 1703.01 states the following:

(k) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.

(l) Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

Diadromous and resident riverine fish are important components of the ecology of the Connecticut River. Fish populations and habitats in the areas affected by the Project should be studied to demonstrate compliance with Env-Wq 1703.19. This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

This requested study will help promote tributary and backwater access and protect valuable fish habitat and maintain appropriate water quality conditions for diadromous and riverine fish species in project-affected areas. Maintaining connectivity between the mainstem of the Connecticut River and tributaries and backwaters is vital to the fish populations in these systems, as many fish species utilize these areas for spawning, rearing, refuge, and feeding.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

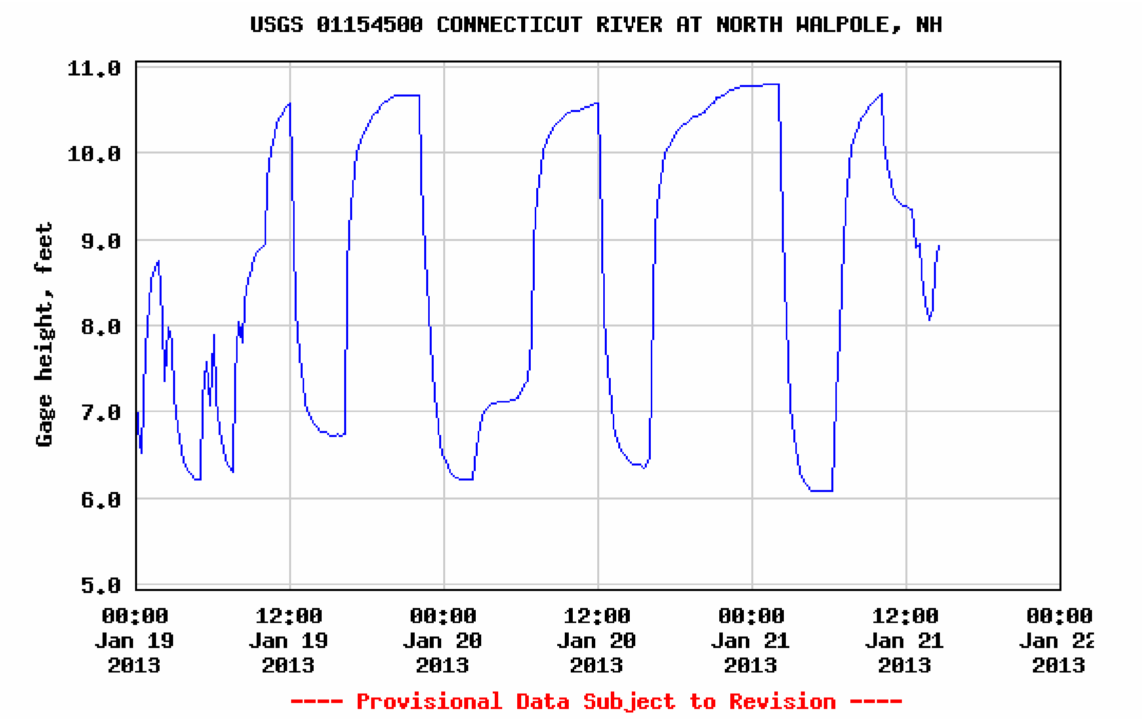
Public Interest

The requestor is a state natural resource agency.

Existing Information

To our knowledge, no information exists related to this requested study.

An example of the water level fluctuations due to hydropower generation that occur in the Lower Connecticut River downstream of the Bellows Falls Project is shown below.



Nexus to Project Operations and Effects

Project operations have the potential to impact fish species life history requirements, biological interactions, and habitat quantity and quality. For example, water level changes due to project operations could create conditions that could impede free movement of fish between tributaries/backwaters and the mainstem of the Connecticut River, thus limiting access to spawning habitat and/or growth opportunities. Additionally, water level changes could also alter tributary and backwater fish habitat quality, quantity, and also water quality, thus decreasing productivity and available habitat. Furthermore, two of New Hampshire and Vermont's SGCN that could be impacted have been documented in the project-affected areas.

Methodology

Common tools to evaluate water level impacts would be used including: bathymetric mapping, substrate, depth and velocity measurements, and water quality information (dissolved oxygen, temperature, turbidity, and pH). Studies should be conducted throughout the year. The study area for tributary and backwater fish sampling should cover all tributaries and backwaters within the project-affected areas of the Vernon, Bellows Falls and Wilder Hydroelectric Projects. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

Level of Effort/Cost

TransCanada does not propose any studies to meet this need. Estimated cost for the study is relatively low.

Literature Cited:

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 18: Impingement and Entrainment of Resident Fish Species at the Wilder, Bellows Falls and Vernon Intakes (FERC NOs 1892, 1855 and 1904)

Goals and Objectives

The goal of this study is to assess the adequacy of the intakes at Bellows Falls, Wilder, and Vernon projects to minimize fish mortality resulting from impingement and entrainment of resident fishes residing in the Connecticut River, and to recommend appropriate mitigative measures as necessary.

Specific objectives include:

- Describe the configuration of the intake at each project, including the forebay characteristics, size of the intakes, trashrack spacing and extent of coverage if the intakes, approach velocities and the influence of trashrack debris and cleaning protocols.
- Estimate the mortality rates for resident fish species and life stages that may result from impingement on project trashracks.
- Estimate the mortality rates for resident fish species and life stages that may result from entrainment and passage through the project turbines. Review existing Vermont Fish and Wildlife Department's (VTFWD) fish passage data to increase sample size and gain a better understanding of temporal variability.
- Determine structural and operational measures that could be reduce resident fish mortality.

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)]. This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

Regarding flow, Env-Wq 1703.01(d) states that "unless the flows are caused by naturally occurring conditions, surface water quantity shall be maintained at levels adequate to protect existing and designated uses."

Regarding Biological and Aquatic Community Integrity, Env-Wq 1703.01 states the following:

(m) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.

(n) Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

Vermont Water Quality Standards (VWQS) seek to provide high quality aquatic habitat necessary to support healthy aquatic communities and the associated uses such as fishing.

The Vermont Fish and Wildlife Department's goals related to aquatic natural resources and pertinent to this study request are to:

1. Provide for healthy, self-sustaining fish communities.
2. Minimize the potential negative effects of project operation on resident fish populations, and mitigate for losses.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The requestor is a state natural resource agency.

Existing Information

The Connecticut River and the project impoundments support a variety of resident fish species as well as angling. However, there is no information about resident fish mortality and the population effects resulting from project impingement and entrainment. The project PADs contain almost no information about the project trashracks. During the ILP site visits held in October 2012 the Agency was informed that the rack spacing was in most cases four inches (on center) and as much as six inches in some cases.

Further, these trashracks do not cover the entire intake area in all cases. No information on approach velocities has been provided. Mortality rates of resident fish passing through the turbines are not known.

Nexus to Project Operations and Effects

The Bellows Falls, Wilder and Vernon dams span across the Connecticut River, acting as a physical impediment to fish passage. Fishes living in the impoundments will at times enter project forebays and come in close proximity to project intakes. Impingement or entrainment is certainly occurring but the extent of this impact is unknown. The wide rack spacing is likely to result in entrainment. The projects include downstream fish passage facilities but their use and effectiveness for resident fish species is unknown. These facilities are operated seasonally and therefore will not mitigate impingement and entrainment at all times.

Methodology Consistent with Accepted Practice

Impingement, entrainment and turbine mortality studies have been conducted at numerous other hydropower projects and can be used to assess potential fish mortality based on results from other projects with similar configurations. Approach velocities can be calculated and actual measurements can be taken to quantify variability by location and verify calculated results. Turbine mortality should be assessed by releasing tagged fish for downstream recovery. The details of this type of study should be addressed during the study plan stage. The contribution of existing downstream fish passage facilities to reducing impingement and entrainment of resident fishes should also be assessed.

Level of Effort/Cost

The expected level of effort and anticipated costs will be comparable or less than those experienced on similar FERC projects of this size.

Literature Cited:

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 19: Assessment of Adult Sea Lamprey (*Petromyzon marinus)* Spawning within the Wilder, Bellows Falls, and Vernon Project Areas. (FERC NOs 1904, 1855, and 1892)

Perform a study to investigate potential impacts of the Wilder, Bellows Falls and Vernon Project's operations on sea lamprey spawning success.

Goals and Objectives

Assess the level of spawning activity by sea lamprey in the Wilder, Bellows Falls, and Vernon project areas and determine whether operations of these Projects are affecting the success (i.e survival to emergence) of this activity.

Identify areas within the Wilder, Bellows Falls, and Vernon project areas where suitable spawning habitat exists for sea lamprey.

Conduct a telemetry study of sea lamprey during their upstream migration period in the spring, focusing on areas of suitable spawning habitat, and areas of known spawning.

Conduct spawning ground surveys to observe the utilization of this habitat for spawning purposes, and hence, confirm suitability.

Obtain data on redd characteristics including location, size, substrate, depth and velocity.

Determine if the operations at the Wilder, Bellows Falls and Vernon projects are adversely affecting these spawning areas (i.e. if flow alterations are causing dewatering and/or scouring of sea lamprey redds). If it is determined that the operations of the projects are adversely affecting the spawning success of sea lamprey, identify operational regimes that will reduce and minimize impacts to sea lamprey spawning habitat and spawning success within the project area.

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)]. This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

Regarding flow, Env-Wq 1703.01(d) states that "unless the flows are caused by naturally occurring conditions, surface water quantity shall be maintained at levels adequate to protect existing and designated uses."

Regarding Biological and Aquatic Community Integrity, Env-Wq 1703.01 states the following:

(o) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.

(p) Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

The sea lamprey (*Petromyzon marinus*), within the Connecticut River drainage, is one of New Hampshire and Vermont's Species of Greatest Conservation Need (SGCN). The conservation status of sea lamprey in New Hampshire is listed as "vulnerable." One of the threats identified in Vermont's Wildlife Action Plan (Kart et al. 2005) is degraded spawning habitat, which is second to habitat fragmentation.

As outlined in Vermont's Wildlife Action Plan (Kart et al. 2005), research and monitoring needs for SGCN include monitoring and assessing populations and habitats for current conditions and future changes, and identifying and monitoring problems for species and their habitats.

One of the conservation strategies identified in the Vermont Wildlife Action Plan, is protecting and restoring aquatic and riparian habitats through improved water quality; flow, water level and temperature regimes; sediment reduction; establishment of streamside buffers; and suitable aquatic habitat structure, diversity and complexity.

In support of conservation strategies and research needs listed above, identifying potential impacts that the Wilder, Bellows Falls, and Vernon Projects have on sea lamprey spawning is paramount. Results of the study will be used to develop flow-related license requirements and/or other mitigation measures that will optimize spawning habitat for a New Hampshire and Vermont SGCN.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq*.), the Federal Power Act (16 U.S.C. §791a, *et seq*.), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The requestor is a state natural resource agency.

Existing Information

It is known that sea lamprey spawn in the Connecticut River main stem at least as far upstream as Wilder Dam, as well as tributary waters including the West, Williams, Black and White Rivers (Kart et al. 2005).

The PAD discusses sea lamprey distribution as: "FWS (2012) lists the current upstream extent of sea lamprey range as Bellows Falls Dam, noting, however, that reproduction has been documented as far north as the White River, Vermont, in the Wilder Project area. In certain years hundreds to thousands of sea lamprey have been recorded passing upstream of Bellow Falls dam, and in at least one year (2008) sea lamprey were documented passing upstream via the Wilder Dam fish ladder. In 2008 surveys, Yoder et al. (2009) documented sea lamprey just downstream of the confluence of the White River ."

In 2012 at total of 99 sea lamprey were observed passing the Bellows Falls Dam, and a total of 696 sea lamprey were observed passing the Vernon Dam.

To date no studies have been conducted that aim to identify spawning habitat and spawning activity of sea lamprey within in the Wilder, Bellows Falls, and Vernon project areas and whether Project operations are affecting these activities.

Nexus to Project Operations and Effects

The operation of the Wilder, Bellows Falls and Vernon projects including minimum flows and large and rapid changes in flow releases from the dam have the potential to cause direct adverse effects on spawning habitat and spawning activity downstream of the dam. If adult sea lampreys are actively spawning in the project area, it is important to assess whether operations of the projects are having any adverse effects (i.e. dewatering and scouring) on these activities.

Methodology Consistent with Accepted Practice

Although a relatively new practice, the tagging and tracking of adult Pacific lamprey to determine final destination, has been successfully conducted in the Columbia River (Noyes et al. 2012). Similarly, from 2005-2009, radio telemetry was used to determine adult lamprey overwintering and spawning habitats, and spawn timing in the lower Deschutes River Subbasin (Fox et al. 2009).

In Vermont, factors affecting sea lamprey survival were examined (Smith and Marsden 2009). It was found that predation, water currents, and displacement of eggs from the nest, played a role in survival. As part of the Wells Hydroelectric project (FERC No. 2149), Pacific lamprey spawning ground surveys were conducted to determine project effects on spawning success.

In 2010, redd surveys were completed in Shitike and Beaver Creeks to identify recent redds for placement of an experimental redd cap. The purpose of capping lamprey redds was to enumerate emerging larvae and to document timing of emergence with respect to estimated date of redd construction and water temperature (Fox et al. 2010). Therefore, to determine project effects on the spawning success of sea lamprey methods should follow Fox et al. (2010).

Level of Effort/Cost

The estimated level of effort and costs for this recommended study is expected to be moderate to high. The applicant did not propose any alternative studies in its PAD to address this specific issue.

Literature Cited

Fox, M. J.C. Graham, and S. Frank. 2009. Determining Adult Pacific Lamprey Abundance and Spawning Habitat in the Lower Dechutes River Sub-Basin, Oregon. Department of Natural Resources Confederated Tribes of the Warm Springs Reservation, Oregon

Fox, M. J.C. Graham, and S. Frank. 2010. Determining Adult Pacific Lamprey Abundance and Spawning Habitat in the Lower Dechutes River Sub-Basin, Oregon. Department of Natural Resources Confederated Tribes of the Warm Springs Reservation, Oregon

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department. Waterbury, Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm. (Accesse September 10, 2012).

Le, Bao and S. Kreiter. 2008. An assessment of Adult Pacific Lamprey Spawning within the Wells Project. Wells Hydroelectric Project NO. 2149.

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Noyes, C.J., C.C. Caudill, T.S. Clabough, D.C. Joosten, E.L. Johnson, M.L. Keefer, and G.P. Naughton. 2011. Adult Pacific lamprey migration behavior and escapement in the Bonneville Reservoir and Lower Columbia River monitored using the juvenile salmonid acoustic telemetry system (JSATS). Technical Report 2012-4-Draft

Smith, S. J. and J. E. Marsden. 2009. Factors Affecting Sea Lamprey Egg Survival. North American Journal of Fisheries Management 29:859–868.

Study Request 20: Determine Upstream Passage Needs for Riverine Fish Species in the Bellows Falls, Wilder and Vernon Fishways (FERC NOs. 1904, 1855, and 1892)

Goals and Objectives

The goal of this study is to determine the adequacy of the existing Bellows Falls, Wilder, and Vernon fish ladders in passing riverine species and determine the appropriate operation period for these fishways to pass riverine and diadromous fish.

Specific objectives include:

- Identify the utilization and temporal distribution, of passage through the Bellows Falls, Wilder, and Vernon fishways by riverine and diadromous fish species
- Review existing Vermont Fish and Wildlife Department's (VTFWD) fish passage data to increase sample size and gain a better understanding of temporal variability.
- Operate and monitor the fishways year-round (or until otherwise infeasible) to assess fishway use over a longer period than the fishways have traditionally been operated to:
    1. Determine the appropriate operating windows of the fishways for riverine species
    2. Determine the appropriate operating windows of the fishways for diadromous species such as American eel and sea lamprey.

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)]. This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

Regarding flow, Env-Wq 1703.01(d) states that "unless the flows are caused by naturally occurring conditions, surface water quantity shall be maintained at levels adequate to protect existing and designated uses."

Regarding Biological and Aquatic Community Integrity, Env-Wq 1703.01 states the following:

(q) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.

(r) Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

The VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Vermont's Wildlife Action Plan 2005). Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Vermont Fish and Wildlife Department's Strategic Plan (2002 -2010) focuses towards four major areas of concern: resource conservation, fish and wildlife-based recreation and use, human health and safety, efficient operations, and effective management.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.

2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.

3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.

4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

In order to be consistent with both Department's missions and goals, and to promote healthy fish populations, connectivity within a river system is important. By allowing fish to move through the fishway during different times of the year, and during different life history stages, access to available riverine aquatic habitat is increased. Fish are able to seek the best available habitat and food resources, as well as avoid predator interactions. Furthermore, movement within a river system promotes genetic diversity. Currently upstream resident fish passage at the Bellows Falls, Wilder, and Vernon dams is precluded most of the year due to fishway closure.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The requestor is a state natural resource agency.

Existing Information

No such information exists that will allow for a comprehensive assessment of existing year round fishway utilization by resident species. The VTFWD has several years (2007-2012) of seasonal passage data that have not yet been analyzed. These data are in the form of .avi files, but only include the spring and summer months (typically May- July).

The PAD acknowledges that "Resident species have also been recorded using the Bellows Falls and Wilder fish ladder". Those data are available from the Vermont Fish & Wildlife Department. Fish passage video data that have been processed should be available for distribution in the future (Lael Will, Vermont Fish & Wildlife, personal communication)". Although not comprehensive, analysis of these data would assist in filling this data gap.

In 2012, VTFWD staff documented resident species passage at the Vernon fishway. Species observed utilizing the fishway included bluegill (N = 555), common carp (N = 209), channel catfish (N = 37), trout sp. (N = 2), walleye (N = 54), white sucker (N = 102), and American eel (N =262). However, these analyses were conducted during one year and did not include any monitoring outside of the spring spawning run.

Nexus to Project Operations and Effects

The Bellows Falls, Wilder and Vernon dams span across the Connecticut River, acting as a physical impediment to fish passage. Therefore, the project has a direct impact on fish passage and limits fish from accessing available aquatic habitat located upstream of the dam. The PAD acknowledges that "river fragmentation can reduce or obstruct fish and aquatic community connectivity and therefore genetic diversity and stock structure. However, those impacts are reduced by the provision of fish passage and the length of the impoundment. Upstream and downstream fish passages, designed for Atlantic salmon, are likely used by other migratory and resident species, providing connectivity; however, fish counts are limited, unknown or unavailable for resident species". In fact, it is known that riverine and diadromous species use the fishways, but there has been limited analysis of this data and fishway monitoring was limited to spring period.

Therefore, in order to determine the level of riverine fish passage through the existing fishways, and the appropriate operation period for the fishway , review of existing data and , further monitoring of the fishways is warranted.

Methodology

Fishway monitoring has been conducted annually by VTFWD dating back to 1985. Monitoring was focused on Atlantic salmon, American shad and American eel. Resident species were recorded periodically, but were not monitored outside the spring anadromous fish migration period

Fishway monitoring has been used to assess existing and proposed project operations, and to develop appropriate operating windows for fisheries resources. In addition to fish window count data, monitoring should include monitoring of the hydraulic conditions in the fishways and fishway entrances, and periodic fish observations should be made over the length of the fishways. If count data or observations of the fishways indicate the need for fishway operation changes or for more specific information on fish movement through the fishways, changes to the monitoring plan for year 2 monitoring would need to be implemented.

Level of Effort/Cost, and Why Alternative Studies will not suffice

This study will require video monitoring equipment, appropriate software (e.g. salmon soft), and personal to read to files, and manage the equipment. Some information already exists in the form of .avi files and past count data and are readily available from VTFWD. No other tool (e.g. radio telemetry) is more appropriate or cost effective for these types of assessments. Cost is relatively low.

Literature Cited:

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 21a: Wilder Hydroelectric Project: Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations (FERC NO.1892)

Goals and Objectives

The goal of this study is to determine how project operations contribute to the shoreline erosion and riverbank failure within the impoundment and downstream of the Wilder Hydro Project.

The objectives of this study are to:

1. determine how water level fluctuations within the minimum and maximum operating range and discharges from peaking operations at the Wilder hydroelectric project contribute to shoreline erosion;

2. identify and determine the effects of shoreline bank erosion and riverbank failure on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.);

3. identify techniques that could be used to mitigate the effects of project operations or other mitigation techniques that could be developed to reduce on riverbank erosion within the impoundment and downstream of the tailrace.

2. Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)]. New Hampshire's surface water quality regulations state that "unless the flows are caused by naturally occurring conditions, surface water quantity shall be maintained at levels adequate to protect existing and designated uses." (Env-Wq 1703.01(d)). The specific New Hampshire water quality criteria for turbidity in Class B waters is not to exceed naturally occurring conditions by more than 10 NTUs (Env-Wq 1703.11). This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

The Connecticut River is considered Class B water by the states of Vermont and New Hampshire. Vermont lists the section of the Connecticut River below the Wilder dam on the Section 303(d) impaired water list due to flow alterations resulting in the destabilization and eroding of shoreline impairing aquatic life and habitat. In Class B waters, Vermont's water quality standards state that water level fluctuation and flow alterations can only occur to the extent that it supports all uses and does not lead to degradation of the water resource or habitat.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest Consideration

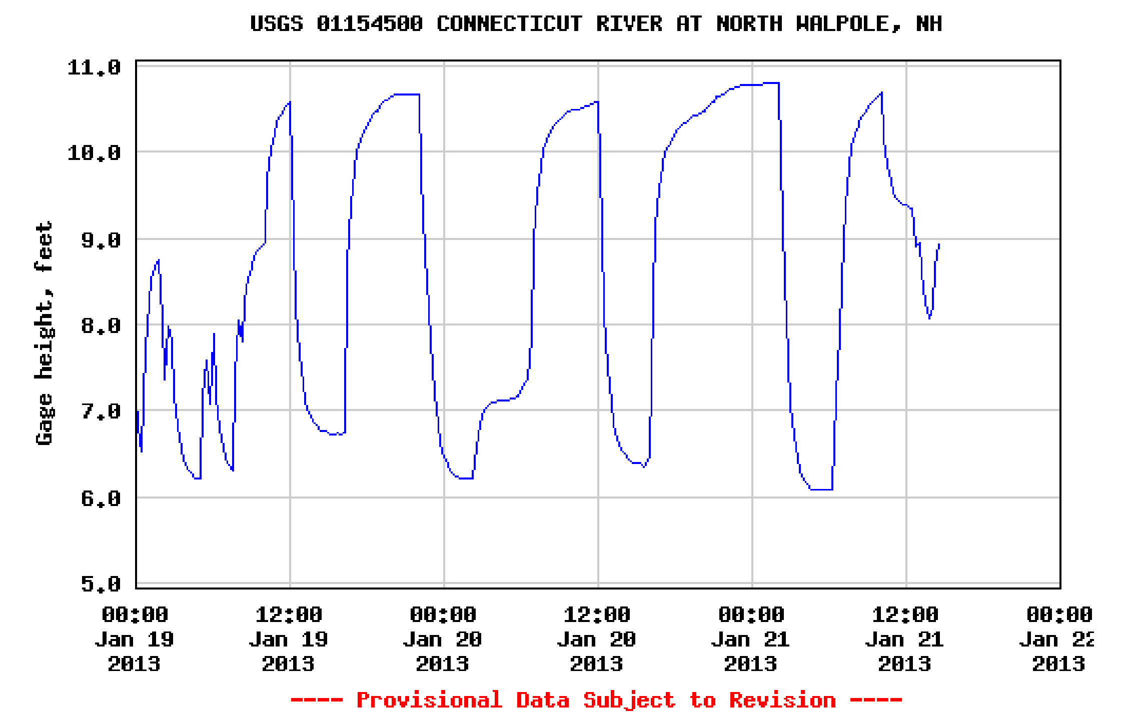
The requestor is a state natural resource agency.

Existing Information

The PAD references several studies pertaining to shoreline erosion within the Connecticut River, including the study by US Army Corp of Engineers (Simion et al. 1979). This study evaluated the shoreline within the Wilder impoundment and identified water level fluctuation and periodic high flow events. The PAD also discusses the erosion survey that TransCanada initiated in 2010 to inventory sites where erosion is occurring within the Wilder impoundment (Kleinschmidt 2011). Bank slumping was identified as the major type of shoreline erosion within the project impoundment. Bank slumping can occur when fluvial erosional forces act on the toe of the bank slope. The PAD did not address how project related operations contribute to shoreline erosion, could be changed to mitigate impacts on shoreline erosion, or discuss the impacts of shoreline erosion on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.).

Repetitive water level fluctuations and flow alterations caused by hydroelectric peaking operations are known to be a major contributor to shoreline erosion (Lawson 1985). Sediment from shoreline erosion and riverbank failure is one of the major contributors negatively affecting water quality and habitat by increasing turbidity and sedimentation, smothering aquatic habitat in the United States. Vermont Surface Water Management Strategy identifies sediment from excessive channel erosion as a stressor on Vermont

water and aquatic habitat. Additionally, Vermont lists this section of the Connecticut River on the Vermont Section 303(d) impaired water list due to flow alterations resulting from the destabilization and eroding of shoreline impairing aquatic life and habitat.
An example of the water level fluctuations that occur in Lower Connecticut River due to hydropower generation downstream of the Bellow Falls Project is shown below.



Project Nexus

Wilder Hydroelectric Project operations currently result in daily water level fluctuation in the impoundment by as much as 2.5 feet, which has the potential to affect shoreline erosion in the impoundment. The project is currently permitted to water level fluctuation in the impoundment by 5 feet. Additionally the project “peaking” operation could contribute to bank erosion downstream of the dam by increasing the shear stress on the bank toe. Furthermore, river profile operations during high flow events minimize overland flow by drawing down the impoundment prior to high flows containing high velocity flows to the river channel, possibly increasing shoreline erosion rate within the impoundment. TransCanada is not proposing any changes to project operations.

Proposed Methodology

Kleinschmidt (2011) conducted a shoreline erosion survey on the Connecticut River, from which we have data on the spatial locations, lengths and heights of such erosion. However, this study did not investigate whether the practice of flow modification is a causative agent to this erosion. Consequently we recommend TransCanada further investigate sites on the Connecticut River to evaluate the processes that are active along banks. This investigation should build on the erosion survey that was previously completed by determining the process causing erosion at a site, the extent erosion is negatively affecting other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.), and determining how erosion could be stabilized or mitigated by changing project operations. This investigation can be completed performing the following tasks.

Task 1: Determine erosion and riverbank failure process at identified sites

Shoreline erosion areas and riverbank failure sites were identified during the Kleinschmidt (2011) survey. A survey similar to Kleinschmidt (2011) should be conducted to document if any additional erosion has occurred, and identify new sites[3] of erosion within the impoundment, given the occurrence of Tropical Storm Irene since the Kleinschmidt survey. For each erosion site, the following erosion process element will be identified by determining soil type and subsoil characteristics (i.e. depth to bedrock, texture, rock content, signs of soil piping), reservoir water levels at the time of observation, water level fluctuation, climatic conditions, ground water seepage, wind-driven waves, boat waves, and recreation. Additional site characteristic to identify and record in the erosion survey will include but not be limited to an estimate of the length and average height of the erosional area, slope of the site, dominant vegetation cover types present, associated vegetation cover types present, an ocular estimate of total plant cover and total cover by plant class (tree, shrub, herbaceous) in surrounding undisturbed areas. Data from each shoreline erosion site will be recorded on a field form and entered into a database. In addition, a photograph or photographs will be taken of each site. Sites. should be visited when water levels are lowest.

Erosion processes will be determined by field observations and applying site appropriate geology, geomorphic and hydrological principles. To evaluate the relative influence of water level fluctuations on existing shoreline erosion, a minimum of six select sites[3] (three in the impoundment and three downstream of the dam) will be identified for more detailed measurements and observations. In aid of site selection, comparison of successive aerial photographs will be conducted to identify sites that have experienced visible bank movement. Data from erosion surveys will be examined to identify sites with varying conditions of riparian buffer, vegetation type and bank slope. The sites selected for detailed evaluation will represent different combinations of bank movement, riparian buffer, vegetation type and bank slope. In those bank sites that are selected, rebar pins will be inserted into the banks in a grid at varying heights with each rebar being horizontally level. Initial rebar pin installation will take place when the water level in the impoundment is at its authorized lowest elevation. Each rebar pin will be assigned an individual number and photographed, with the distance from the end of the pin to the bank material measured. A survey will also be conducted of each bank along several bank transects in the vicinity of each site to accurately document bank shape as well as the location and elevation of each rebar and the water surface elevation at the beginning and end of each site visit. Pressure transducers (one in the air and one in the water) will also be installed at each site to automatically record how water surface elevation at each site varies with time.

Biweekly for a period of one year, each of the six sites will be revisited. During each revisit, the bank and each rebar pin will be photographed and the distance from the end of the pin to the bank material will be measured. Any slumping of a pin will be noted. If a pin is found dislodged or removed during a site visit, a new rebar pin will be reinstalled in the approximate location of the previously existing pin.. In addition,

[3] Representatives from the City of Lebanon have informed the NH Department of Environmental Services that they are particularly concerned with the damage and erosion caused by Tropical Storm Irene below the Wilder project in the vicinity of the White River confluence. They want to understand the impacts of Project operations and discharge from the Whiter River on channel and riverbank destabilization in this area and identify strategies to minimize their effects. This should be one of the areas studied as part of this study request.

a survey of the bank and rebars will be conducted. Surveys will always be conducted in the same manner and will use the same benchmark each site visit. Data from pressure transducers will be downloaded and analyzed each site visit to ensure they are working properly. When this dataset is related to the flow record from existing stream gauges in the river segment, this evaluation will allow for a determination as to whether the erosion is Project related, and if so, how Project operations may be impacting the sites.

Task 2: Determining the effects of erosion on other resources

The effects of shoreline erosion and riverbank failure on other resources should be determined. This will required coordination between studies to determine the effects of erosion on riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, and recreation. Erosion sites identified as having an impact on resources will be assess to determine if project operations are causing erosion and a mitigation plan to protect the resource of interest should be developed.

Task 3: Development of a Shoreline Management Plan

The information that is collected during the study should be used to develop a Shoreline Management Plan for the impoundment. If results from the erosion evaluation suggest that Project operations are impacting erosion within the impoundment, further evaluation should be undertaken to determine if there is a feasible way to reduce impacts. This feasibility analysis will be based on field observations and knowledge of current erosion control and slope failure stabilization methods that may be suitable for sites. The analysis will provide a preliminary list of potential control measures necessary to reduce erosion at these sites. Detailed analyses for final design and construction of erosion and slope stabilization control measures will not be part of the study. As part of this process, the landowner should be identified for each of the erosion sites and future mitigation and stabilization techniques should be presented.

The study area for the shoreline erosion study should extend from the upstream end of the impoundment above the Wilder Dam to the beginning of the impoundment below the Wilder Dam. Water level fluctuations caused by the Project may affect not only the impoundment but also the downstream river reaches below the dam.

Level of Effort and Cost

The cost and effort of this study will be moderate, but is important to document the potential impact project operations on shoreline erosion and riverbank failure, and to determine how this may impact other resources.

Literature Cited

Kleinschmidt (Kleinschmidt Associates, Inc.). 2011. Lower Connecticut River Shoreline Survey Report – 2010: Bellows Falls Project (FERC No. 1855), Wilder Project (FERC No. 1892), Vernon Project (FERC No. 1904). Draft Report March 2011. Prepared for TransCanada Hydro Northeast Inc.,Westborough, MA.

Lawson, D.E., 1985, Erosion of northern reservoir shores: An analysis and application of pertinent literature: US Army Corps of Engineers Cold Regions Research and Engineering Laboratory Monograph 85-1, 198 p.

Simons, D.B., Andrews, J.W., Li, R.M., and Alawady, M.A. 1979. Connecticut River Streambank Erosion Study Massachusetts, New Hampshire, and Vermont. Prepared for USACE, New England Division.

Study Request 21b: Bellows Falls Hydroelectric Project: Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations (Docket Number p-1855)

Goals and Objectives

The goal of this study is to determine how project operations contribute to the shoreline erosion and riverbank failure within the impoundment and downstream of the Bellows Falls Hydroelectric Project.

The objectives of this study are to:

1. determine how water level fluctuations within the minimum and maximum operating range and discharges from peaking operations at the Bellows Falls hydroelectric project contribute to shoreline erosion;

2. identify and determine the effects of shoreline bank erosion and riverbank failure on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.);

3. identify techniques that could be used to mitigate the effects of project operations or other mitigation techniques that could be developed to reduce on riverbank erosion within the impoundment and downstream of the tailrace.

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)]. New Hampshire's surface water quality regulations state that "unless the flows are caused by naturally occurring conditions, surface water quantity shall be maintained at levels adequate to protect existing and designated uses." (Env-Wq 1703.01(d)). The specific New Hampshire water quality criteria for turbidity in Class B waters is not to exceed naturally occurring conditions by more than 10 NTUs (Env-Wq 1703.11). This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

The Connecticut River is considered Class B water by the states of Vermont and New Hampshire. Vermont lists the section of the Connecticut River below the Wilder dam on the Section 303(d) impaired water list due to flow alterations resulting in the destabilization and eroding of shoreline impairing aquatic life and habitat. In Class B waters, Vermont's water quality standards state that water level fluctuation and flow alterations can only occur to the extent that it supports all uses and does not lead to degradation of the water resource or habitat.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.

2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.

3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.

4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq*.), the Federal Power Act (16 U.S.C. §791a, *et seq*.), and the Clean Water Act (33 U.S.C. §1251 *et seq*.).

Public Interest Consideration

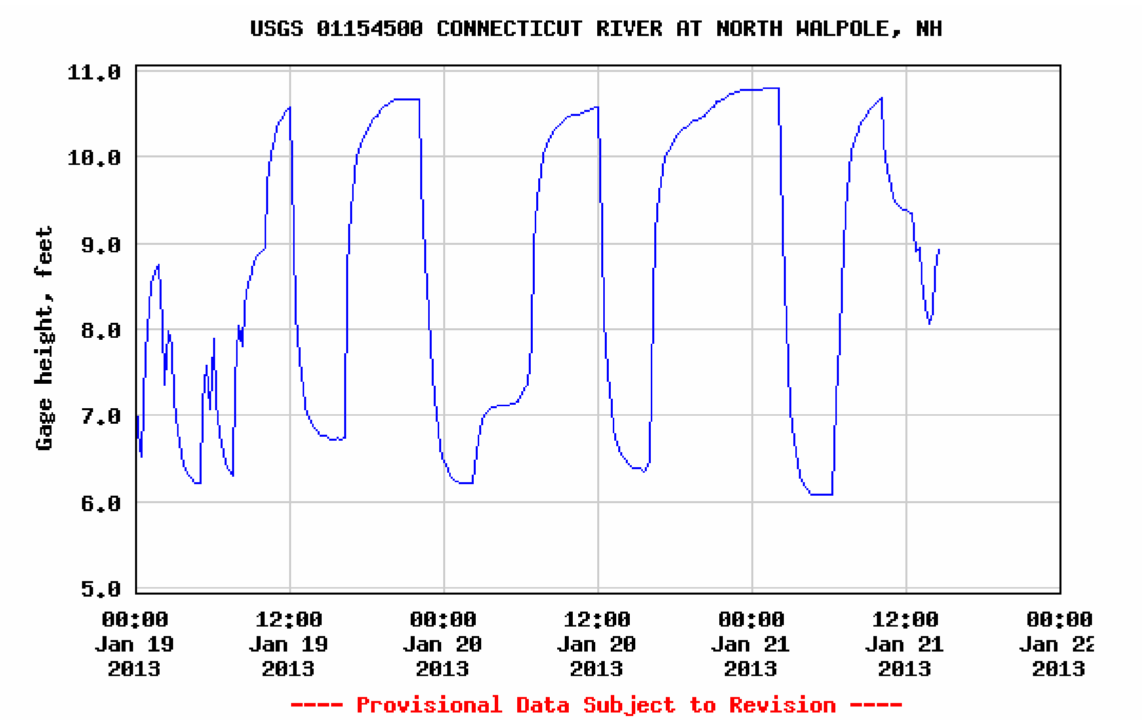
The requestor is a state natural resource agency.

Existing Information

The PAD references several studies pertaining to shoreline erosion within the Connecticut River, including the study by US Army Corp of Engineers (Simion et al. 1979). This study evaluated the shoreline within the Wilder impoundment and identified water level fluctuation and periodic high flow events. The PAD also discusses the erosion survey that TransCanada initiated 2010 to inventory sites where erosion is occurring within the Bellows Falls impoundment (Kleinschmidt 2011). Bank slumping was identified as the major type of shoreline erosion within the project impoundment. Bank slumping can occur when fluvial erosional forces act on the toe of the bank slope. The PAD did not address how project related operations contribute to shoreline erosion, could be changed to mitigate impacts on shoreline erosion, or discuss the impacts of shoreline erosion on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.).

Repetitive water level fluctuations and flow alterations caused by hydroelectric peaking operations are known to be a major contributor to shoreline erosion (Lawson 1985). Sediment from shoreline erosion and riverbank failure is one of the major contributors negatively affecting water quality and habitat by increasing turbidity and sedimentation, smothering aquatic habitat in the United States. Vermont Surface Water Management Strategy identifies sediment from excessive channel erosion as a stressor on Vermont water and aquatic habitat. Additionally, Vermont lists this section of the Connecticut River on the Vermont Section 303(d) impaired water list due to flow alterations resulting from the destabilization and eroding of shoreline impairing aquatic life and habitat.

An example of the water level fluctuations that occur in Lower Connecticut River due to hydropower generation downstream of the Bellows Falls Project is shown below.



Project Nexus

Bellows Falls Hydroelectric Project operations currently result in daily water level fluctuation in the impoundment by approximately 2 feet, which has the potential to affect shoreline erosion in the impoundment. The project is currently permitted to water level fluctuation in the impoundment by 3 feet. Additionally the project "peaking" operation could contribute to bank erosion downstream of the dam by increasing the shear stress on the bank toe. Furthermore, river profile operations during high flow events minimize overland flow by drawing down impoundment prior to high flows containing high velocity flows to the river channel, possibly increasing shoreline erosion rate within the impoundment. TransCanada is not proposing any changes to project operations.

Methodology

Kleinschmidt (2011) conducted a shoreline erosion survey on the Connecticut River, from which we have data on the spatial locations, lengths and heights of such erosion. However, this study did not investigate whether the practice of flow modification is a causative agent to this erosion. Consequently we recommend TransCanada further investigate sites on the Connecticut River to evaluate the processes that are active along banks. This investigation should build on the erosion survey that was previously completed by determining the process causing erosion at a site, the extent erosion is negatively affecting other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.), and determining how erosion could be stabilized or mitigated by changing project operations. This investigation can be completed performing the following tasks.

Task 1: Determine erosion and riverbank failure process at identified sites

Shoreline erosion areas and riverbank failure sites were identified during the Kleinschmidt (2011) survey. A survey similar to Kleinschmidt (2011) should be conducted to document if any additional erosion has occurred, and identify new sites of erosion within the impoundment, given the occurrence of Tropical Storm Irene since the Kleinschmidt survey. For each erosion site, the following erosion process element will be identified by determining soil type and subsoil characteristics (i.e. depth to bedrock, texture, rock content, signs of soil piping), reservoir water levels at the time of observation, water level fluctuation, climatic conditions, ground water seepage, wind-driven waves, boat waves, and recreation. Additional site characteristic to identify and record in the erosion survey will include but not be limited to an estimate of the length and average height of the erosional area, slope of the site, dominant vegetation cover types present, associated vegetation cover types present, an ocular estimate of total plant cover and total cover by plant class (tree, shrub, herbaceous) in surrounding undisturbed areas. Data from each shoreline erosion site will be recorded on a field form and entered into a database. In addition, a photograph or photographs will be taken of each site. Sites. should be visited when water levels are lowest.

Erosion processes will be determined by field observations and applying site appropriate geology, geomorphic and hydrological principles. To evaluate the relative influence of water level fluctuations on existing shoreline erosion, a minimum of six select sites (three in the impoundment and three downstream of the dam) will be identified for more detailed measurements and observations. In aid of site selection, comparison of successive aerial photographs will be conducted to identify sites that have experienced visible bank movement. Data from erosion surveys will be examined to identify sites with varying conditions of riparian buffer, vegetation type and bank slope. The sites selected for detailed evaluation will represent different combinations of bank movement, riparian buffer, vegetation type and bank slope. In those bank sites that are selected, rebar pins will be inserted into the banks in a grid at varying heights with each rebar being horizontally level. Initial rebar pin installation will take place when the water level in the impoundment is at its authorized lowest elevation. Each rebar pin will be assigned an individual number and photographed, with the distance from the end of the pin to the bank material measured. A survey will also be conducted of each bank along several bank transects in the vicinity of each site to accurately document bank shape as well as the location and elevation of each rebar and the water surface elevation at the beginning and end of each site visit. Pressure transducers (one in the air and one in the water) will also be installed at each site to automatically record how water surface elevation at each site varies with time.

Biweekly for a period of one year, each of the six sites will be revisited. During each revisit, the bank and each rebar pin will be photographed and the distance from the end of the pin to the bank material will be measured. Any slumping of a pin will be noted. If a pin is found dislodged or removed during a site visit, a new rebar pin will be reinstalled in the approximate location of the previously existing pin.. In addition, a survey of the bank and rebars will be conducted. Surveys will always be conducted in the same manner and will use the same benchmark each site visit. Data from pressure transducers will be downloaded and analyzed each site visit to ensure they are working properly. When this dataset is related to the flow record from existing stream gauges in the river segment, this evaluation will allow for a determination as to whether the erosion is Project related, and if so, how Project operations may be impacting the sites.

Task 2: Determining the effects of erosion on other resources

The effects of shoreline erosion and riverbank failure on other resources should be determined. This will required coordination between studies to determine the effects of erosion on riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, and recreation. Erosion sites identified as having an impact on resources will be assess to determine if project operations are causing erosion and a mitigation plan to protect the resource of interest should be developed.

Task 3: Development of a Shoreline Management Plan

The information that is collected during the study should be used to develop a Shoreline Management Plan for the impoundment. If results from the erosion evaluation suggest that Project operations are impacting erosion within the impoundment, further evaluation should be undertaken to determine if there is a feasible way to reduce impacts. This feasibility analysis will be based on field observations and knowledge of current erosion control and slope failure stabilization methods that may be suitable for sites. The analysis will provide a preliminary list of potential control measures necessary to reduce erosion at these sites. Detailed analyses for final design and construction of erosion and slope stabilization control measures will not be part of the study. As part of this process, the landowner should be identified for each of the erosion sites and future mitigation and stabilization techniques should be presented.

The study area for the shoreline erosion study should extend from the upstream end of the impoundment above the Bellows Falls Dam to the beginning of the impoundment below the Bellows Falls Dam. Water level fluctuations caused by the Project may affect not only the impoundment but also the downstream river reaches below the dam.

Level of Effort and Cost

The cost and effort of this study will be moderate, but is important to document the potential impact project operations on shoreline erosion and riverbank failure, and to determine how this may impact other resources.

Literature Cited

Kleinschmidt (Kleinschmidt Associates, Inc.). 2011. Lower Connecticut River Shoreline Survey Report – 2010: Bellows Falls Project (FERC No. 1855), Wilder Project (FERC No. 1892), Vernon Project (FERC No. 1904). Draft Report March 2011. Prepared for TransCanada Hydro Northeast Inc.,Westborough, MA.

Lawson, D.E., 1985, Erosion of northern reservoir shores: An analysis and application of pertinent literature: US Army Corps of Engineers Cold Regions Research and Engineering Laboratory Monograph 85-1, 198 p.

Simons, D.B., Andrews, J.W., Li, R.M., and Alawady, M.A. 1979. Connecticut River Streambank Erosion Study Massachusetts, New Hampshire, and Vermont. Prepared for USACE, New England Division.

Study Request 21c: Vernon and Turners Falls Hydroelectric Projects: Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations in New Hampshire (FERC NOs. 1904 and 1889)

Goals and Objectives

The goal of this study is to determine how project operations contribute to the shoreline erosion and riverbank failure within the impoundment and downstream of the Vernon Hydroelectric Project and in the portion of the Turners Falls impoundment in New Hampshire.

The objectives of this study are to:

1. determine how water level fluctuations within the minimum and maximum operating range and discharges from peaking operations at the Vernon hydroelectric project contribute to shoreline erosion;

2. identify and determine the effects of shoreline bank erosion and riverbank failure on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.);

3. identify techniques that could be used to mitigate the effects of project operations or other mitigation techniques that could be developed to reduce on riverbank erosion within the impoundment and downstream of the tailrace.

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)]. New Hampshire's surface water quality regulations state that "unless the flows are caused by naturally occurring conditions, surface water quantity shall be maintained at levels adequate to protect existing and designated uses." (Env-Wq 1703.01(d)). The specific New Hampshire water quality criteria for turbidity in Class B waters is not to exceed naturally occurring conditions by more than 10 NTUs (Env-Wq 1703.11). This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

The Connecticut River is considered Class B water by the states of Vermont and New Hampshire. Vermont lists the section of the Connecticut River below the Wilder dam on the Section 303(d) impaired water list due to flow alterations resulting in the destabilization and eroding of shoreline impairing aquatic life and habitat. In Class B waters, Vermont's water quality standards state that water level fluctuation and flow alterations can only occur to the extent that it supports all uses and does not lead to degradation of the water resource or habitat.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq*.), the Federal Power Act (16 U.S.C. §791a, *et seq*.), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest Consideration

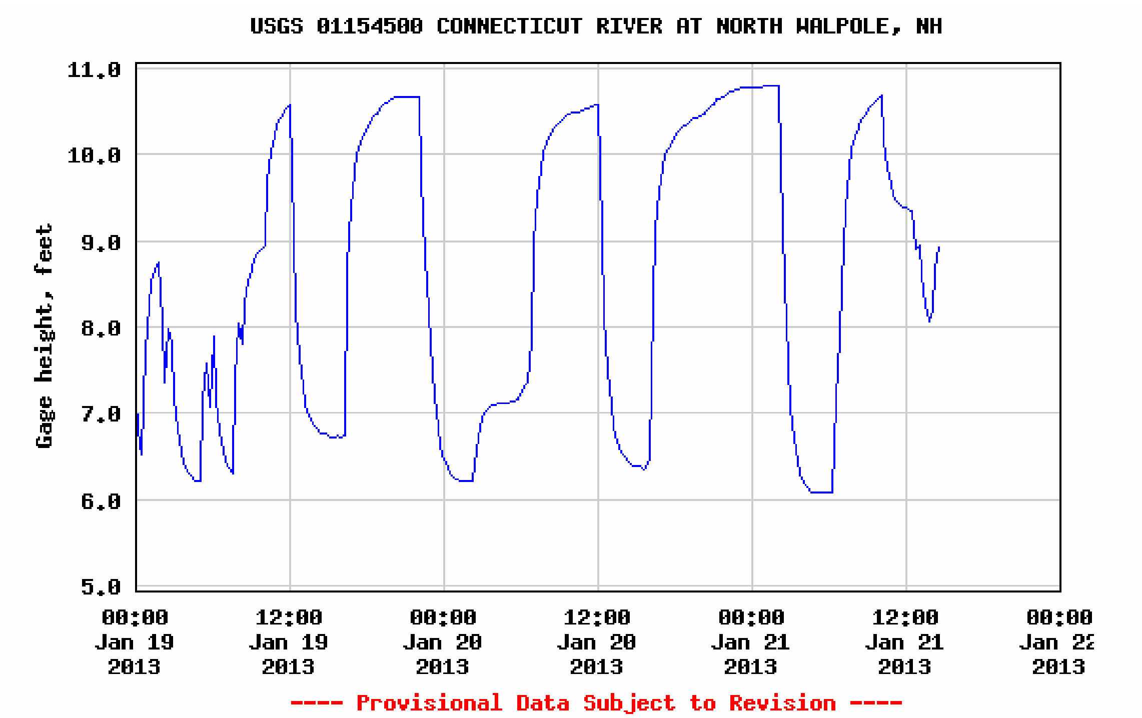
The requestor is a state natural resource agency.

Existing Information

The PAD references several studies pertaining to shoreline erosion within the Connecticut River, including the study by US Army Corp of Engineers (Simion et al. 1979). This study evaluated the shoreline within the Wilder impoundment and identified water level fluctuation and periodic high flow events. The PAD also discusses the erosion survey that TransCanada initiated 2010 to inventory sites where erosion is occurring within the Bellows Falls impoundment (Kleinschmidt 2011). Bank slumping was identified as the major type of shoreline erosion within the project impoundment. Bank slumping can occur when fluvial erosional forces act on the toe of the bank slope. The PAD did not address how project related operations contribute to shoreline erosion, could be changed to mitigate impacts on shoreline erosion, or discuss the impacts of shoreline erosion on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.).

Repetitive water level fluctuations and flow alterations caused by hydroelectric peaking operations are known to be a major contributor to shoreline erosion (Lawson 1985). Sediment from shoreline erosion and riverbank failure is one of the major contributors negatively affecting water quality and habitat by increasing turbidity and sedimentation, smothering aquatic habitat in the United States. Vermont Surface Water Management Strategy identifies sediment from excessive channel erosion as a stressor on Vermont water and aquatic habitat. Additionally, Vermont lists this section of the Connecticut River on the Vermont Section 303(d) impaired water list due to flow alterations resulting from the destabilization and eroding of shoreline impairing aquatic life and habitat.

An example of the water level fluctuations that occur in Lower Connecticut River due to hydropower generation downstream of the Bellows Falls Project is shown below.



Project Nexus

Vernon Hydroelectric Project operations currently result in daily water level fluctuation in the impoundment of approximately 2 feet, with a maximum permitted fluctuation of 8 feet. Turners Falls Hydroelectric Project operations currently result in daily water level fluctuation in the impoundment of approximately 3.7 feet, with a maximum permitted fluctuation of 9 feet. Both projects have the potential to affect shoreline erosion in their respective impoundments.. Additionally the project “peaking” operation could contribute to bank erosion downstream of the dams by increasing the shear stress on the bank toe

Methodology

Kleinschmidt (2011) conducted a shoreline erosion survey on the Connecticut River, from which we have data on the spatial locations, lengths and heights of such erosion. However, this study did not investigate whether the practice of flow modification is a causative agent to this erosion. Consequently, the Vermont Agency of Natural Resources and the New Hampshire Department of Environmental Services recommend TransCanada further investigate sites on the Connecticut River to evaluate the processes that are active along banks. This investigation should build on the erosion survey that was previously completed by determining the process causing erosion at a site, the extent erosion is negatively affecting other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.), and determining how erosion could be stabilized or mitigated by changing project operations. This investigation can be completed performing the following tasks.

Task 1: Determine erosion and riverbank failure process at identified sites

Shoreline erosion areas and riverbank failure sites were identified during the Kleinschmidt (2011) survey. A survey similar to Kleinschmidt (2011) should be conducted to document if any additional erosion has occurred, and identify new sites of erosion within the impoundment, given the occurrence of Tropical Storm Irene since the Kleinschmidt survey. For each erosion site, the following erosion process element will be identified by determining soil type and subsoil characteristics (i.e. depth to bedrock, texture, rock content, signs of soil piping), reservoir water levels at the time of observation, water level fluctuation, climatic conditions, ground water seepage, wind-driven waves, boat waves, and recreation. Additional site characteristic to identify and record in the erosion survey will include but not be limited to an estimate of the length and average height of the erosional area, slope of the site, dominant vegetation cover types present, associated vegetation cover types present, an ocular estimate of total plant cover and total cover by plant class (tree, shrub, herbaceous) in surrounding undisturbed areas. Data from each shoreline erosion site will be recorded on a field form and entered into a database. In addition, a photograph or photographs will be taken of each site. Sites. should be visited when water levels are lowest.

Erosion processes will be determined by field observations and applying site appropriate geology, geomorphic and hydrological principles. To evaluate the relative influence of water level fluctuations on existing shoreline erosion, a minimum of six select sites (three in the impoundment and three downstream of the dam) will be identified for more detailed measurements and observations. In aid of site selection, comparison of successive aerial photographs will be conducted to identify sites that have experienced visible bank movement. Data from erosion surveys will be examined to identify sites with varying conditions of riparian buffer, vegetation type and bank slope. The sites selected for detailed evaluation will represent different combinations of bank movement, riparian buffer, vegetation type and bank slope. In those bank sites that are selected, rebar pins will be inserted into the banks in a grid at varying heights with each rebar being horizontally level. Initial rebar pin installation will take place when the water level in the impoundment is at its authorized lowest elevation. Each rebar pin will be assigned an individual number and photographed, with the distance from the end of the pin to the bank material measured. A survey will also be conducted of each bank along several bank transects in the vicinity of each site to accurately document bank shape as well as the location and elevation of each rebar and the water surface elevation at the beginning and end of each site visit. Pressure transducers (one in the air and one in the water) will also be installed at each site to automatically record how water surface elevation at each site varies with time.

Biweekly for a period of one year, each of the six sites will be revisited. During each revisit, the bank and each rebar pin will be photographed and the distance from the end of the pin to the bank material will be measured. Any slumping of a pin will be noted. If a pin is found dislodged or removed during a site visit, a new rebar pin will be reinstalled in the approximate location of the previously existing pin.. In addition, a survey of the bank and rebars will be conducted. Surveys will always be conducted in the same manner and will use the same benchmark each site visit. Data from pressure transducers will be downloaded and analyzed each site visit to ensure they are working properly. When this dataset is related to the flow record from existing stream gauges in the river segment, this evaluation will allow for a determination as to whether the erosion is Project related, and if so, how Project operations may be impacting the sites.

Task 2: Determining the effects of erosion on other resources

The effects of shoreline erosion and riverbank failure on other resources should be determined. This will required coordination between studies to determine the effects of erosion on riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, and recreation. Erosion sites identified as having an impact on resources will be assess to determine if project operations are causing erosion and a mitigation plan to protect the resource of interest should be developed.

Task 3: Development of a Shoreline Management Plan

The information that is collected during the study should be used to develop a Shoreline Management Plan for the impoundment. If results from the erosion evaluation suggest that Project operations are impacting erosion within the impoundment, further evaluation should be undertaken to determine if there is a feasible way to reduce impacts. This feasibility analysis will be based on field observations and knowledge of current erosion control and slope failure stabilization methods that may be suitable for sites. The analysis will provide a preliminary list of potential control measures necessary to reduce erosion at these sites. Detailed analyses for final design and construction of erosion and slope stabilization control measures will not be part of the study. As part of this process, the landowner should be identified for each of the erosion sites and future mitigation and stabilization techniques should be presented.

The study area for the shoreline erosion study should extend from the upstream end of the impoundment above the Vernon Dam to at least the New Hampshire / Massachusetts border. Water level fluctuations caused by the Project may affect not only the impoundment but also the downstream river reaches below the dam.

Level of Effort and Cost

The cost and effort of this study will be moderate, but is important to document the potential impact project operations on shoreline erosion and riverbank failure, and to determine how this may impact other resources.

Literature Cited

Kleinschmidt (Kleinschmidt Associates, Inc.). 2011. Lower Connecticut River Shoreline Survey Report – 2010: Bellows Falls Project (FERC No. 1855), Wilder Project (FERC No. 1892), Vernon Project (FERC No. 1904). Draft Report March 2011. Prepared for TransCanada Hydro Northeast Inc.,Westborough, MA.

Lawson, D.E., 1985, Erosion of northern reservoir shores: An analysis and application of pertinent literature: US Army Corps of Engineers Cold Regions Research and Engineering Laboratory Monograph 85-1, 198 p.

Simons, D.B., Andrews, J.W., Li, R.M., and Alawady, M.A. 1979. Connecticut River Streambank Erosion Study Massachusetts, New Hampshire, and Vermont. Prepared for USACE, New England Division

Study Request 22a: Continuous water temperature monitoring (15 minute intervals) at various locations within the Wilder Hydroelectric Project Impoundment and Tailrace, and Connecticut River downstream of the Wilder Dam (FERC NO. 1892)

Goals and Objectives

The goal of this study is to determine the potential impacts (both project specific and cumulative) of the Wilder Hydroelectric Project operations on hourly/daily temperature fluctuations and spatial thermal distribution within the Wilder Hydroelectric Project Impoundment and Tailrace**,** and the Connecticut River downstream of the Wilder Dam.

The objectives of this study are to:

1. Obtain continuous temperature data (every 15 minutes) at various locations and depths throughout the project impoundment, tailrace, and downstream Connecticut River using temperature loggers;

2. Analyze data for hourly/daily shifts in temperature regime and thermal distribution (aquatic isotherm maps) associated project specific and cumulative impacts associated with project operations; and

3. Determine if any shifts in hourly temperature regime or thermal distribution are impacting aquatic habitat within the project impoundment and tailrace and lower Connecticut River (e.g., thermal blocks to migration, thermal stress, habitat degradation).

Resource Management Goals

Temperature is an important habitat consideration for many aquatic species including migratory fish and rare, threatened, endangered species. Temperature influences the distribution, behavior, metabolism, growth, reproduction, and survival of fishes (Diana 2004).

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)].

Regarding flow, Env-Wq 1703.01(d) states that "unless the flows are caused by naturally occurring conditions, surface water quantity shall be maintained at levels adequate to protect existing and designated uses."

Regarding Biological and Aquatic Community Integrity, Env-Wq 1703.01 states the following:

(s) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.

(t) Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

This study request will inform the 401 water quality certification process and help ensure that State water quality standards such as Env-Wq 1703.19 will be met.

The Connecticut River is considered a Class B waters cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Additionally the Vermont Water Quality Standards states that in Class B cold water fish habitat, the total increase in from any activity or discharge should not result in a temperature increase that exceeds 1.0°F.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The requestor is a state natural resource agency.

Existing Information

The PAD provides limited information on impacts of project operations ("daily run-of-river") on temperature in the project impoundment, tailrace or lower Connecticut River. Hourly/daily temperature shifts associated with project operations at Wilder Dam can impact aquatic habitat rendering it unsuitable for some organisms. The information in the PAD does not define the spatial extent of temperatures (aquatic isotherm map) within the impoundment, lower Connecticut River. The PAD mainly indicates that in general, temperature did increase from upstream to downstream while dissolved oxygen decreased, reflecting the impacts of the impoundment.

Nexus to Project Operations and Effects

The project impounds 45 miles of river that would otherwise be free flowing. It currently operates in a peaking mode, with allowable impoundment fluctuations of up to 5 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (675 cfs). Water temperature can be affected by the operating mode of a hydropower project. The impounded water increases the water surface area of the river reach containing the project. The increased surface acts as a large solar radiation collector and the thermal mass of the impounded water acts a heat sink storing heat from solar radiation. At night the increased surface area may act as convective radiator that releases heat. Together these attributes may contribute to unnatural thermal properties in the project impoundment that may impact natural temperature regime and influence habitat conditions for fish, wildlife and plant resources (temperature tolerance, life cycle timing (e.g., reproduction or migration), and food availability). The project discharges regulated Connecticut River flows ("daily run-of-river") from the impoundment to the downstream seventeen mile reach of the Connecticut River. The project can sporadically release large volumes of impoundment water that may be of a different temperature than the receiving water downstream of the dam. Unnatural and rapid shifts in temperature regimes in the downstream water can impact fish, wildlife and plant resources and instream habitat. The NHFGD requests that more recent temperature data is collected in a more intensive, systematic and scientific manner in order to assess project specific and cumulative impacts on fish, wildlife and plant resources at the project. Results from this study may be used to directly inform the evaluation of project effects on related resources, such as a fish and other aquatic species.

Methodology Consistent with Accepted Practice

Use of temperature loggers to gain information on thermal trends has been a standard technique to look at impacts of water storage associated with hydroelectric projects. We recommend that transects be established in the upper, middle, and lower project impoundment, as well as in the tailrace and downstream project. An additional transect should be established in the free flowing section of river above the impoundment to serve as a "reference site". Inexpensive temperature loggers should be deployed along each transects at a minimum of three locations: at depths of 1 meter subsurface, mid-depth, and 1 meter off the bottom (on buoy lines) where water depths permit. The temperature loggers should be deployed from April 1 – November 15 and be set to record temperature at 15 minute intervals. The temperature loggers should be checked and the data downloaded on the monthly basis. The data from the loggers should then be used to develop hourly/daily aquatic isotherm maps, and temperature change and distribution as a result of project and cumulative impacts should be assessed.

Level of Effort/Cost, and Why Alternative Studies will not suffice

The effort and cost of this study is expected to be moderate to high, but the potential project specific and cumulative thermal alteration impacts have never been studied in a comprehensive manner and their potential impacts to aquatic habitat and fish, wildlife, and resources has not been adequately studied.

Literature Cited

Diana, J.S. 2004. Biology and Ecology of Fishes. 2nd edition. Biological Sciences Press.

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 22b: Continuous water temperature monitoring (15 minute intervals) at various locations within the Bellows Falls Hydroelectric Project Impoundment and Tailrace, and Connecticut River downstream of the Bellows Falls Dam (FERC NO. 1855)

Goals and Objectives

The goal of this study is to determine the potential impacts (both project specific and cumulative) of the Bellows Falls Hydroelectric Project operations on hourly/daily temperature fluctuations and spatial thermal distribution within the Bellows Falls Hydroelectric Project Impoundment and Tailrace**,** and the Connecticut River downstream of the Bellows Falls Dam.

The objectives of this study are to:

1. Obtain continuous temperature data (every 15 minutes) at various locations and depths throughout the project impoundment, tailrace, and downstream Connecticut River using temperature loggers;

2. Analyze data for hourly/daily shifts in temperature regime and thermal distribution (aquatic isotherm maps) associated project specific and cumulative impacts associated with project operations; and

3. Determine if any shifts in hourly temperature regime or thermal distribution are impacting aquatic habitat within the project impoundment and tailrace and lower Connecticut River (e.g., thermal blocks to migration, thermal stress, habitat degradation).

Resource Management Goals

Temperature is an important habitat consideration for many aquatic species including migratory fish and rare, threatened, endangered species. Temperature influences the distribution, behavior, metabolism, growth, reproduction, and survival of fishes (Diana 2004).

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)].

Regarding flow, Env-Wq 1703.01(d) states that "unless the flows are caused by naturally occurring conditions, surface water quantity shall be maintained at levels adequate to protect existing and designated uses."

Regarding Biological and Aquatic Community Integrity, Env-Wq 1703.01 states the following:

(u) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.

(v) Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

This study request will inform the 401 water quality certification process and help ensure that State water quality standards such as Env-Wq 1703.19 will be met.

The Connecticut River is considered a Class B waters cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Additionally the Vermont Water Quality Standards states that in Class B cold water fish habitat, the total increase in from any activity or discharge should not result in a temperature increase that exceeds 1.0°F.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq*.), the Federal Power Act (16 U.S.C. §791a, *et seq*.), and the Clean Water Act (33 U.S.C. §1251 *et seq*.).

Public Interest

The requestor is a state natural resource agency.

Existing Information

The PAD provides limited information on impacts of project operations (“daily run-of-river”) on temperature in the project impoundment, tailrace or lower Connecticut River. Hourly/daily temperature shifts associated with project operations at Bellows Falls Dam can impact aquatic habitat rendering it unsuitable for some organisms. The information in the PAD does not define the spatial extent of temperatures (aquatic isotherm map) within the impoundment, lower Connecticut River. The PAD mainly indicates that in general, temperature did increase from upstream to downstream while dissolved oxygen decreased, reflecting the impacts of the impoundment.

Nexus to Project Operations and Effects

The project impounds 26 miles of river that would otherwise be free flowing. It currently operates in a peaking mode, with allowable impoundment fluctuations of up to 3 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1083 cfs). Water quality can be affected by the operating mode of a hydropower project. The PAD provides limited information on how project operations affect water quality within the project impoundment, bypass reach and tailrace. Water temperature can be affected by the operating mode of a hydropower project. The impounded water increases the water surface area of the river reach containing the project. The increased surface acts as a larger solar radiation collector and the thermal mass of the impounded water acts a heat sink storing heat from solar radiation. At night the increased surface area may act as convective radiator that releases heat. Together these attributes may contribute to unnatural thermal properties in the project impoundment that may impact natural temperature regime and influence habitat conditions for fish, wildlife and plant resources (temperature tolerance, life cycle timing (e.g., reproduction or migration), and food availability).

The project discharges regulated Connecticut River flows (“daily run-of-river”) from the impoundment to the downstream seventeen mile reach of the Connecticut River. The project can sporadically release large volumes of impoundment water that may be of a different temperature than the receiving water downstream of the dam. Unnatural and rapid shifts in temperature regimes in the downstream water can impact fish, wildlife and plant resources and instream habitat. The NHFGD requests that more recent temperature data is collected in a more intensive, systematic and scientific manner in order to assess project specific and cumulative impacts on fish, wildlife and plant resources at the project. Results from this study may be used to directly inform the evaluation of project effects on related resources, such as a fish and other aquatic species.

Methodology Consistent with Accepted Practice

Use of temperature loggers to gain information on thermal trends has been a standard technique to look at impacts of water storage associated with hydroelectric projects. We recommend that transects be established in the upper, middle, and lower project impoundment, as well as in the tailrace and downstream project. An additional transect should be established in the free flowing section of river above the impoundment to serve as a “reference site”. Inexpensive temperature loggers should be deployed along each transects at a minimum of three locations: at depths of meter subsurface, mid-depth, and 1 meter off the bottom (on buoy lines) where water depths permit. The temperature loggers should be deployed from April 1 – November 15 and be set to record temperature at 15 minute intervals. The temperature loggers should be checked and the data downloaded on the monthly basis. The data from the loggers should then be used to develop hourly/daily aquatic isotherm maps, and temperature change and distribution as a result of project and cumulative impacts should be assessed.

Level of Effort/Cost, and Why Alternative Studies will not suffice

The effort and cost of this study is expected to be moderate to high, but the potential project specific and cumulative thermal alteration impacts have never been studied in a comprehensive manner and their potential impacts to aquatic habitat and fish, wildlife, and resources has not been adequately studied.

Literature Cited

Diana, J.S. 2004. Biology and Ecology of Fishes. 2nd edition. Biological Sciences Press.

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 22c: Continuous water temperature monitoring (15 minute intervals) at various locations within the Vernon Hydroelectric Project Impoundment and Tailrace, and Connecticut River downstream of the Vernon Dam (FERC NO. 1904)

Goals and Objectives

The goal of this study is to determine the potential impacts (both project specific and cumulative) of the Vernon Hydroelectric Project operations on hourly/daily temperature fluctuations and spatial thermal distribution within the Vernon Hydroelectric Project Impoundment and Tailrace**,** and the Connecticut River downstream of the Vernon Dam.
The objectives of this study are to:

1. Obtain continuous temperature data (every 15 minutes) at various locations and depths throughout the project impoundment, tailrace, and downstream Connecticut River using temperature loggers;

2. Analyze data for hourly/daily shifts in temperature regime and thermal distribution (aquatic isotherm maps) associated project specific and cumulative impacts associated with project operations; and

3. Determine if any shifts in hourly temperature regime or thermal distribution are impacting aquatic habitat within the project impoundment and tailrace and lower Connecticut River (e.g., thermal blocks to migration, thermal stress, habitat degradation).

Resource Management Goals

Temperature is an important habitat consideration for many aquatic species including migratory fish and rare, threatened, endangered species. Temperature influences the distribution, behavior, metabolism, growth, reproduction, and survival of fishes (Diana 2004).

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)].

Regarding flow, Env-Wq 1703.01(d) states that "unless the flows are caused by naturally occurring conditions, surface water quantity shall be maintained at levels adequate to protect existing and designated uses."

Regarding Biological and Aquatic Community Integrity, Env-Wq 1703.01 states the following:

(w) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.

(x) Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

This study request will inform the 401 water quality certification process and help ensure that State water quality standards such as Env-Wq 1703.19 will be met.

The Connecticut River is considered a Class B waters cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Additionally the Vermont Water Quality Standards states that in Class B cold water fish habitat, the total increase in from any activity or discharge should not result in a temperature increase that exceeds 1.0°F.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The requestor is a state natural resource agency.

Existing Information

The PAD provides limited information on impacts of project operations ("daily run-of-river") on temperature in the project impoundment, tailrace or lower Connecticut River. Hourly/daily temperature shifts associated with project operations at Bellows Falls Dam can impact aquatic habitat rendering it unsuitable for some organisms. The information in the PAD does not define the spatial extent of temperatures (aquatic isotherm map) within the impoundment, lower Connecticut River. The PAD mainly indicates that in general, temperature did increase from upstream to downstream while dissolved oxygen decreased, reflecting the impacts of the impoundment.

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Nexus to Project Operations and Effects

The project impounds 26 miles of river that would otherwise be natural free-flowing. It currently operates in a peaking mode, with allowable impoundment fluctuations of up to 8 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1250 cfs). Water temperature can be affected by the operating mode of a hydropower project. The impounded water increases the water surface area of the river reach containing the project. The increased surface acts as a larger solar radiation collector and the thermal mass of the impounded water acts a heat sink storing heat from solar radiation. At night the increased surface area may act as convective radiator that releases heat. Together these attributes may contribute to unnatural thermal properties in the project impoundment that may impact natural temperature regime and influence habitat conditions for fish, wildlife and plant resources (temperature tolerance, life cycle timing (e.g., reproduction or migration), and food availability).

The project discharges regulated Connecticut River flows ("daily run-of-river") from the impoundment to the downstream seventeen mile reach of the Connecticut River. The project can sporadically release large volumes of impoundment water that may be of a different temperature than the receiving water downstream of the dam. Unnatural and rapid shifts in temperature regimes in the downstream water can impact fish, wildlife and plant resources and instream habitat. The NHFGD requests that more recent temperature data is collected in a more intensive, systematic and scientific manner is needed to assess project specific and cumulative impacts on fish, wildlife and plant resources at the project. Results from this study may be used to directly inform the evaluation of project effects on related resources, such as a fish and other aquatic species.

Methodology Consistent with Accepted Practice

Use of temperature loggers to gain information on thermal trends has been a standard technique to look at impacts of water storage associated with hydroelectric projects. We recommend that transects be established in the upper, middle, and lower project impoundment, as well as in the tailrace and downstream project. An additional transect should be established in the free flowing section of river above the impoundment to serve as a "reference site". Inexpensive temperature loggers should be deployed along each transects at a minimum of three locations: at depths of meter subsurface, mid-depth, and 1 meter off the bottom (on buoy lines) where water depths permit. The temperature loggers should be deployed from April 1 – November 15 and be set to record temperature at 15 minute intervals. The temperature loggers should be checked and the data downloaded on the monthly basis. The data from the loggers should then be used to develop hourly/daily aquatic isotherm maps, and temperature change and distribution as a result of project and cumulative impacts should be assessed.

Level of Effort/Cost, and Why Alternative Studies will not suffice

The effort and cost of this study is expected to be moderate to high, but the potential project specific and cumulative thermal alteration impacts have never been studied in a comprehensive manner and their potential impacts to aquatic habitat and fish, wildlife, and resources has not been adequately studied.

Literature Cited

Diana, J.S. 2004. Biology and Ecology of Fishes. 2nd edition. Biological Sciences Press.

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 23: Project Effects on Populations of Tessellated Darter, *Etheostoma olmstedi* (FERC NO. 1904, 1855 and 1892)

Goals and Objectives

The goal of this study is to evaluate the effects of project operations on populations of tessellated darter (*Etheostoma olmstedi*), a New Hampshire species of greatest conservation concern and known host species for the federally-endangered dwarf wedgemussel (*Alasmidonta heterodon*). The specific objectives of the study are to:

> Objective 1: Determine the distribution and abundance of tessellated darter within project-affected areas; and
>
> Objective 2: Determine the effects of project operations on the distribution and abundance of tessellated darter.

Relevant Resource Management Goals and Public Interest Considerations

The tessellated darter is one of only three fish species in the Upper Connecticut River that serve as hosts for the glochidia of the federally-endangered dwarf wedgemussel, the others being the slimy sculpin (*Cottus cognatus*) and the Atlantic salmon (*Salmo salar*) (Wicklow 2005). Tessellated darters may be the most important hosts for the dwarf wedgemussel in the Upper Connecticut for the following reasons:

- The USFWS has decided to end its program of stocking hatchery-reared salmon in the Connecticut River basin and accordingly it is unlikely that salmon parr will be available as potential hosts.
- The tessellated darter appears to be more widespread than the slimy sculpin in the Bellow Falls and Wilder project areas where the dwarf wedgemussel is known to exist. Yoder et. al. (2009) found the darter in the project areas upstream and downstream of both dams, while the sculpin was not found in either project area.

It is the goal of the USFWS to recover the dwarf wedgemussel so that it can be removed from the Endangered Species list in the future. Populations in the Upper Connecticut River are dependent on healthy tessellated darter populations, and therefore a better understanding of how dam operations affect the darter is crucial to the recovery of the dwarf wedgemussel.

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)].

Regarding flow, Env-Wq 1703.01(d) states that "unless the flows are caused by naturally occurring conditions, surface water quantity shall be maintained at levels adequate to protect existing and designated uses."

Regarding Biological and Aquatic Community Integrity, Env-Wq 1703.01 states the following:

(y) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.

(z) Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

This study request will inform the 401 water quality certification process and help ensure that State water quality standards such as Env-Wq 1703.19 will be met.

A mission of both the New Hampshire Fish and Game Department (NHFGD) and the Vermont Fish and Wildlife Department is to protect and conserve fish and wildlife and their habitats. Riverine fish species are an important component of the river's ecology. Tessellated darter is identified by New Hampshire as a Species of Greatest Concern.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Existing Information and Need for Additional Information

In the Preliminary Application Documents (PADs) for the Wilder, Bellows Falls, and Vernon projects, the applicant acknowledges that tessellated darter is one of the confirmed hosts of dwarf wedgemussel. It also identifies the occurrence of tessellated darter both upstream and downstream of each project. However, studies that specifically target small-bodied benthic species are lacking in project-affected areas. It is therefore likely that results of previous investigations are biased and underestimate true population size. An effective evaluation of project effects on a population will require robust, unbiased estimates of population parameters such as abundance or occupancy and similar estimates of population parameters under known conditions of low to no effect.

Existing literature indicates that tessellated darters may be found in a variety of habitats (Scott and Crossman 1979, Van Snik Gray and Stauffer 1999, Hartel 2002, Van Snik Gray et al. 2005, Henry and Grossman 2008), but these habitats are not necessarily equal in their ability to support the population or its function as host to dwarf wedgemussel. We cannot be certain that habitat use infers preference, nor that habitat use will be consistent from basin to basin. Therefore, habitat use within project-affected areas should be evaluated, and should be evaluated in concert with population parameters. By estimating population parameters (e.g., abundance, occupancy, extinction/colonization) as functions of habitat, we may determine whether habitat contributes to any differences in populations and if so, what specific habitat is preferred for stable and persistent populations.

Project Nexus

Operations at the Wilder, Bellows Falls, and Vernon projects alter natural river flow and consequently cause changes in the availability of instream habitat on which the tessellated darter and other lotic species depend. Habitat for tessellated darters is directly related to project operations in terms of flow (water depth and velocity, and their timing, duration, frequency, and rate of change) as well as the interactions of flow with other habitat variables such as substrata, vegetation, and cover. Operations both upstream (changes to the reservoir) and downstream (changes to the flow regime) may affect habitat, and may consequently lead to changes in the distribution, abundance, and behavior of tessellated darters that could in turn potentially affect the federally-endangered dwarf wedge mussel, for which the tessellated darter is a host species.

The information collected for this requested study will help determine whether project operations have a substantial effect on populations of tessellated darter, or whether population parameters are consistent with those of other populations in the region. If there is an effect of project operations on darter populations, study results will also permit identification of those habitat components related to operations that are most important for maintenance of stable and persistent populations of tessellated darter. This will in turn provide information that will assist the development of recommendations aimed to maintain populations of dwarf wedgemussel.

Proposed Methodology

Using an accepted and robust field sampling design (e.g., as described in Pollock et al. 2002 or MacKenzie et al. 2006) and accepted methods for collecting tessellated darters and other similar small-bodied fishes, conduct a field survey for tessellated darters within all projectaffected areas from the headwaters of the Wilder pool downstream to the Vernon dam, as well as in selected areas outside of the project-affected areas with known stable populations of tessellated darter and/or dwarf wedgemussel. Such a sampling design should include replicate samples for estimation of species detection probability. For each replicate sample, collect and record data that may be important for describing differences in populations of tessellated darter, such as presence or abundance of other species (e.g., dwarf wedgemussel, slimy sculpin *Cottuscognatus*), depth, velocity, water temperature, substrata, time of day, presence of cover, proportion of vegetation cover, size of individuals collected (juveniles may select different habitat; larger individuals may outcompete smaller individuals for preferred habitat), and other factors as determined by a qualified biologist. Include also as covariates any relevant flow characteristics (Zimmerman 2006) that may differ among sites.

Using methods as described by Kery et al. (2005), MacKenzie et al. (2006), or Wenger and Freeman (2008), determine whether population estimates of tessellated darter are different in project-affected areas and, if so, which measured factors or flow characteristics are most important in describing these differences.

Level of Effort and Cost

The cost for collecting the data for this study is entirely dependent on the number of sites, number of sample replicates, and the extent of the covariate data that are measured, all of which and should be determined during the development of the study plan in consultation with fishery agencies and other parties, and may be adjusted during the course of field sampling. In general, if a species is common and easily captured, few replicates and many sites produce the best estimates, whereas more replicates and fewer sites are preferable for rare species. In general, the more replicates added, the lower the errors in detection probability, and the more sites sampled, the lower the errors in population parameters. The number of people required in the field will be dependent on the sampling method that is selected, but should be at least two individuals. Provided the collected data are of high quality, analysis and synthesis should take at most 5-10 days.

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Henry, B.E., and G.D. Grossman. 2008. Microhabitat use by blackbanded (*Percina nigrofasciata*), turquoise (*Etheostoma inscriptum*), and tessellated *(E. olmstedi*) dartersduring drought in a Georgia piedmont stream. Environmental Biology of Fishes 83:171-182.

Hartel, K.E., D.B. Halliwell, and A.E. Launer. 2002. *Inland Fishes of Massachusetts*. Massachusetts Audubon Society: Lincoln, MA.

Kery, M., J.A. Royle, and H. Schmid. 2005. Modeling avian abundance from replicated counts using binomial mixture models. Ecological Applications 15:1450-1461.

MacKenzie, D.I., J.D. Nichols, J.A. Royle, K.H. Pollock, L.L. Bailey, and J.E. Hines. 2006. Occupancy estimation and modeling: inferring patterns and dynamics of species occurrence. Elsevier: San Diego, California.

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Van Snik Gray, E. and J.R. Stauffer, Jr. 1999. Comparative microhabitat use of ecologically similar benthic fishes. Environmental Biology of Fishes 56:443-453.

Van Snik Gray, E., K.A. Kellogg, and J.R. Stauffer, Jr. 2005. Habitat shift of a native darter *Etheostoma olmstedi* (Teleostei: Percidae) in sympatry with a non-native darter *Etheostoma zonale*. American Midland Naturalist 154:166-177.

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Wicklow, B. 2005. in New Hampshire Wildlife Action Plan. New Hampshire Fish and Game Department, Concord, NH, 03301. pp. A26-A35.

Yoder, C.O., L.E. Hersha, & B. Appel. 2009. Fish assemblage and habitat assessment of the Upper Connecticut River: preliminary results and data presentation. Final Project Report to: U.S. EPA, Region 1, Boston, MA. Center for Applied Bioassessment & Biocriteria. Midwest Biodiversity Institute. Columbus, OH.

Zimmerman, J.K.H. 2006. Response of physical processes and ecological targets to altered hydrology in the Connecticut River basin. The Nature Conservancy, Connecticut River Program, Northampton, MA.

Study Request 24: Upstream American Eel Passage Assessment at Vernon, Bellows Falls and Wilder Projects (FERC NOs. 1904, 1855 and 1892)

Goals and Objectives

This study has two objectives:

1. Conduct systematic surveys of eel presence/abundance at tailrace and spillway locations at the Vernon, Bellows Falls, and Wilder projects to identify areas of concentration of eels staging in pools or attempting to ascend wetted structures that would potentially establish the most effective locations to place upstream eel passage facilities.

2. Collect eels with temporary trap/pass devices from areas identified from surveys as potential locations of eel concentration to assess whether eels can be collected/passed in substantial numbers, and whether locations are viable sites for permanent eel trap/pass structures.

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)].

Regarding flow, Env-Wq 1703.01(d) states that "unless the flows are caused by naturally occurring conditions, surface water quantity shall be maintained at levels adequate to protect existing and designated uses."

Regarding Biological and Aquatic Community Integrity, Env-Wq 1703.01 states the following:

(aa) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.

(bb) Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

This study request will inform the 401 water quality certification process and help ensure that State water quality standards such as Env-Wq 1703.19 will be met.

The Atlantic States Marine Fisheries Commission has developed two documents related to the management of American eel:

1 Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.
2 Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

In addition, the Connecticut River Atlantic Salmon Commission (CRASC) developed the draft document: A Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin in 2005. The goal of the plan is "to protect and enhance the abundance of the American eel resource to ensure its continued role in the Connecticut River Basin ecosystem…" Management objectives in the plan include the following:

1 Protect and enhance eel populations where they currently exist;
2 Where practical, restore populations to waters where they had historical abundance;
3 Provide effective upstream and downstream fish passage around dams and other barriers within the species' range in the basin; and
4 Comply with all requirements of the Fishery Management Plan of the ASMFC.

Based on these plans, the New Hampshire Fish and Game Department (NHFGD) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the three projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to upstream passage of American eel, the NHFGD's goals are:

1. Minimize current and potential negative project operation effects that could hinder management goals and objectives.
2. Minimize project-related sources of upstream passage delay, injury, and stress in order to facilitate access to historical rearing habitat.

The American eel (*Anguilla rostrata*), is also one of New Hampshire and Vermont's Species of Greatest Conservation Need (SGCN). The status for conservation need in Vermont is listed as high priority (Kart et al. 2005), and the species is listed as "vulnerable" in New Hampshire. As identified in Vermont's Wildlife Action Plan (Kart et al. 2005), threats to the species include the construction of large dams on rivers which obstruct juvenile fish access to critical rearing habitats, as well as mortality associated with passing through hydroelectric facilities' turbines during their outmigration to sea.

As outlined in Vermont's Wildlife Action Plan (Kart et al. 2005), research and monitoring needs for this SGCN include determining their distribution and abundance, as the contribution of eels in northern regions to overall stock is unknown. One of the conservation strategies for this species is to support efforts to enhance access of American eels to Vermont waters by eliminating or minimizing impacts of dams and other obstructions along the Richelieu, St. Lawrence, and Connecticut Rivers.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The requestor is a state natural resource agency.

Existing Information

The PAD contains no information relative to areas where eels seeking to move upstream concentrate downstream of the three dams, or annual numbers of eels attempting to ascend past the dams. While eels have been known to ascend the Vernon and Bellows Falls fish ladders, their efficiency for passing eels is unknown, and they are only operated during the American shad passage season (from April 15 through July 15). Eels are currently able to pass Vernon, Bellows Falls, and Wilder dams (as evidenced by documented presence of eels upstream), but the total number of eels attempting to pass all three dams and the proportion successfully passing each project is unknown (but suspected to be low). The downstream Holyoke Project has operated upstream eel passage facilities since 2004. Last year these facilities passed over 40,000 juvenile eels. While the next dam upstream (the Turners Falls Project; FERC No. 1889) has no dedicated upstream eel passage facilities, eels have been known to ascend the Cabot Station fish ladder (A. Haro, U.S. Geological Survey, pers. comm.). Although there is rearing habitat in between the Turners Falls and Vernon dams, some eels will attempt to continue upstream, and passage needs to be provided so these fish can access historical habitat.

These information gaps need to be filled so resource agencies can determine the best locations to site upstream eel passage facilities and assess whether operating the existing anadromous ladders would be an effective mechanism to move juvenile eels upstream past the projects.

We also note that within the past seven years, the United States Fish and Wildlife Service (USFWS) has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005 the USFWS issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability. On September 29, 2011 the USFWS issued a substantial 90-day finding and initiated a 12-month status review. It is our understanding that the USFWS is still accepting new American eel information for the ongoing status review.

Nexus to Project Operations and Effects

The three projects generate hydropower on the head created by the Vernon, Bellows Falls, and Wilder dams. These dams create barriers to upstream migrating eels. While some eels are able to pass dams, some are not, and the passability of a given dam depends on factors such as its height, hydraulics, presence of climbable surfaces, presence of predators, risk of exposure to heat or drying while climbing a dam, etc. All three dams are high (Vernon: 58 ft. high; Bellows Falls: 30 ft. high; and Wilder: 60 ft. high), and the majority of the dam faces are dry during most of the upstream eel passage season. Design of the dams is not currently amenable to passage of eels by climbing. As mentioned earlier, the existing anadromous passage facilities are not designed to pass eels, and even if some eels are able to ascend the ladders, they may incur delays (in attraction or passage rates), be size-selective (e.g. velocity barrier for small eels presented by ~8 ft/sec flow through weirs and orifices), present a potential predation risk (predators in or near the fishways), and are not operated throughout the upstream eel passage season.

Methodology Consistent with Accepted Practice

1. Objective 1: Systematic Surveys

Surveys of eel presence and relative abundance should be conducted at regular intervals throughout the eel upstream migratory season (~1 May to ~15 October, or when river temperatures exceed 10 C). Surveys should consist of visual inspection and trapping in likely areas where eels may concentrate as they attempt to climb structures wetted by significant spill or leakage flow below the dams and associated structures. These locations include: the upstream fish ladders at all three projects (dewatered state) and leakage or overflow points along the downstream faces of all three dams, including spillways. Methods should include visual surveys (on foot, from a boat, or snorkeling) and trapping using small mesh (< 1/8" clear opening) baited eel pots. Visual surveys should be performed once per week, at night, preferentially during precipitation events. Trap sets should be performed once per week, with an overnight soak time. Recorded data should include location, observation of eels (presence, absence, relative numbers, relative sizes, behaviors, time/date of observation), and survey method.

2. Objective 2: Trap/Pass Collections

Areas identified from Systematic Surveys as having significant number of eels present should be targeted as potential areas for permanent eel trap/passes, and should be initially assessed using temporary/portable trap passes. At a minimum (regardless of survey results), temporary trap passes should be installed at stilling basins and/or lower sections of fishways supplied with minimal attraction flow (0.5-1.0 cfs) during dewatered conditions at all three projects , as these locations may be supplemented with additional attraction flow and have high potential for being concentration points for upstream migrant eels. Similarly, traps should also be placed at spillway or bypass channel locations where eels have a potential to climb wetted (e.g., via leakage) flow zones, at the highest points where eels are able to climb to, or where otherwise feasible. Temporary trap/passes should be purpose-designed and built for each location, and operated throughout the eel upstream migratory season (~1May to 15 October, or when river temperatures exceed 10° C). Ramp-type traps with supplementary attraction flow are preferred temporary trap/pass designs. Traps should operate daily, with catches quantified every 2-3 days. Recorded data should include location, trapping interval, absolute numbers of eels trapped, relative eel sizes, and hydraulic and environmental conditions during the trapping period.

All collected eels from surveys should be released at their point of capture; those eels collected from trap/pass collections should be transported to and released into the headponds upstream of where they were collected.

These methodologies are consistent with accepted practice.

Level of Effort/Cost

The level of cost and effort for the survey component of the study would be low for each individual project (moderate for all three projects combined); a minimal number of personnel may be able to conduct the weekly surveys. The trap/pass component would require low to moderate cost and effort.
We are not aware of any previously conducted or ongoing studies related to upstream eel passage. The applicant did not propose any studies to meet this need in the PAD.

Literature Cited

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department. Waterbury, Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm. (Accessed September 10, 2012).

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 25a: Wilder Hydroelectric Project: Water quality monitoring within the project impoundment and tailrace (FERC NO. 1892)

Goal and Objective

The goal of this study is to determine if the operational impacts of the Wilder Hydroelectric Project are causing or contributing to violations of New Hampshire and/or Vermont state water quality standards.

The objective of this study will be to collect water temperature, dissolved oxygen, specific conductance, pH, turbidity, nutrients, and chlorophyll-a data at multiple locations in the project area. This monitoring effort will consist of both instantaneous measurements and continuous data collected via multi-parameter dataloggers. Data should be collected under normal and peak operating conditions and ambient conditions that include periods of low flow and higher water temperatures. Turbidity readings can provide an approximation of the total suspended solids concentration and therefore of erosion due to peaking operations. Dataloggers equipped with turbidity probes should be deployed at locations up and downstream of the dam to help document the effects of peaking operations on bank erosion and should be coordinated with other study requests regarding bank erosion. Weekly profiles and grab samples should reflect various flow conditions. The water quality data will be compared to both Vermont and New Hampshire water quality standards to determine if the project is causing or contributing to water quality standard violations.

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)].

New Hampshire surface water criteria for Biological and Aquatic Community Integrity, Env-Wq 1703.01 states the following:

> (a) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

New Hampshire surface water criteria for turbidity are provided in Env-Wq 1703.11.

This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Vermont lists the section of the Connecticut River below the Wilder dam on the Section 303(d) impaired water list due to flow alterations aquatic life and habitat.

All sections of the Connecticut River related to the project are classified by New Hampshire as Class B. It should be noted that although the classification name is the same as Vermont's, New Hampshire surface water criteria for Class B waters, are in some cases, different from Vermont's.

Public Interest Consideration

The requestor is a state natural resource agency.

Existing Information

The PAD contains information on water quality monitoring that was completed between June 20, 2012 and September 11, 2012 in the tailrace and just upstream of the dam. The data indicated that Vermont Water Quality Standards for dissolved oxygen were not met during a seven day period in August and New Hampshire dissolved oxygen standards were close to being violated (average daily percent saturation of 77.5 percent at W-01 as compared to the criterion of 75% average daily percent saturation and 5.66 mg/L as compared to the instantaneous minimum criterion of 5.0 mg/L). The PAD does not provide information on the water quality throughout the impoundment or how water quality is affected by project operations. The PAD does indicate that in general temperature, specific conductance, and pH did increase from upstream to downstream while dissolved oxygen decreased, reflecting the impacts of the impoundment. To our knowledge, no turbidity data was collected.

Project Nexus

The project impounds 45 miles of river that would otherwise be free flowing. It currently operates in a peaking mode, with allowable impoundment fluctuations of up to 5 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (675 cfs). Water quality can be affected by the operating mode of a hydropower project. The PAD provides limited information on how project operations affect water quality within the project impoundment and tailrace.

Operations of the project must conform to Vermont and New Hampshire water quality standards. The Vermont Agency of Natural Resources and the New Hampshire Department of Environmental Services request a study that will provide the data needed to determine if the Connecticut River in the vicinity of the Wilder Hydroelectric Project is or is not attaining the water quality standards of both states.

Proposed Methodology

The methodology for this study should be similar to TransCanada's water quality monitoring in 2012 including weekly vertical profiles within the impoundment, weekly water quality samples of nutrients and chlorophyll-a for laboratory analysis and the deployment of multi-parameter continuous dataloggers at multiple locations within the impoundment and tailrace. An additional site should be monitored in the free flowing section of the river above the impoundment to serve as a "reference site". At each designated datalogger monitoring location at least 10 days of data should be collected at 15 minute increments during a period of low flow ($\leq$3 x 7Q10) and high temperatures (preferably over 23 degrees C) between June 1 and September 30. Dataloggers deployed in the impoundment should be set at the bottom of the epilimnion (if stratified) or at 25% depth if not stratified. A vertical dissolved oxygen and water temperature profile should be conducted at the time of deployment of dataloggers in the impounded section to determine if river is stratified and thus the appropriate depth for deployment. Dataloggers equipped with turbidity probes should be deployed at locations up and downstream of the dam for several months to help document the effects of peaking operations on bank erosion. Placement of dataloggers with turbidity probes should be coordinated with other studies regarding erosion. Water quality results should be graphically compared to both state water quality standards and project operations, including the generation status, impoundment elevation, and discharge.

If low flow conditions are not met the first year of the study, a second year of data may be necessary.

It is preferable that the water quality monitoring for all projects be coordinated so that sampling can occur at each location within each project during the same period of time and under the same operational, flow, and environmental conditions.

Level of Effort and Cost

The cost and effort of this study will be moderate, but is important to document the potential impact operations have on water quality and determine if they meet Vermont and New Hampshire water quality standards.

Study Request 25b: Bellow Falls Hydroelectric Project: Water quality monitoring within the project impoundment, bypass, and tailrace (FERC NO. 1855)

Goal and Objective

The goal of this study is to determine if the operational impacts of the Bellows Falls Hydroelectric Project are causing or contributing to violations of New Hampshire and/or Vermont state water quality standards.

The objective of this study will be to collect water temperature, dissolved oxygen, specific conductance, pH, turbidity, nutrients, and chlorophyll-a data at multiple locations in the project area. This monitoring effort will consist of both instantaneous measurements and continuous data collected via multi-parameter dataloggers. Data should be collected under normal and peak operating conditions and ambient conditions that include periods of low flow and higher water temperatures. Turbidity readings can provide an approximation of the total suspended solids concentration and therefore of erosion due to peaking operations. Dataloggers equipped with turbidity probes should be deployed at locations up and downstream of the dam to help document the effects of peaking operations on bank erosion and should be coordinated with other study requests regarding bank erosion. Weekly profiles and grab samples should reflect various flow conditions. The water quality data will be compared to both Vermont and New Hampshire water quality standards to determine if the project is causing or contributing to water quality standard violations.

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)].

New Hampshire surface water criteria for Biological and Aquatic Community Integrity, Env-Wq 1703.01 states the following:

> (a) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

New Hampshire surface water criteria for turbidity are provided in Env-Wq 1703.11.

This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Vermont lists the section of the Connecticut River below the Wilder dam on the Section 303(d) impaired water list due to flow alterations aquatic life and habitat.

All sections of the Connecticut River related to the project are classified by New Hampshire as Class B. It should be noted that although the classification name is the same as Vermont's, New Hampshire surface water criteria for Class B waters, are in some cases, different from Vermont's.

Public Interest Consideration

The requestor is a state natural resource agency.

Existing Information

The PAD contains information on water quality monitoring that was completed between June 20, 2012 and September 12, 2012 in the tailrace, bypass reach and just upstream of the dam. Additionally, weekly water column profiles were collected at three locations within the impoundment. The data indicated that Vermont and New Hampshire water quality standards for dissolved oxygen were not met in the bypass reach and in the impoundment. Furthermore, pH readings collected in water profile measurements indicated that in two different locations during two separate events in the impoundment did not meet Vermont and New Hampshire water quality standards. Continuous monitoring at BF-01 recorded a maximum pH of 8.53 which can be indicative of algal growth (the growth of which can be exacerbated by the higher temperatures typically found in impoundments. The PAD does not provide information on the continuous water quality throughout the impoundment or how water quality is affected by project operations. The PAD indicates that in general temperature, specific conductance, and pH did increase from upstream to downstream while dissolved oxygen decreased, reflecting the impacts of the impoundment.

Project Nexus

The project impounds 26 miles of river that would otherwise be free flowing. It currently operates in a peaking mode, with allowable impoundment fluctuations of up to 3 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1083 cfs). Water quality can be affected by the operating mode of a hydropower project. The PAD provides limited information on how project operations affect water quality within the project impoundment, bypass reach and tailrace. Operations of the project must conform to Vermont and New Hampshire water quality standards. The NHFGD requests a study that will provide the data needed to determine if the Connecticut River in the vicinity of the Bellows Falls Hydroelectric Project is or is not attaining the water quality standards of both states.

Proposed Methodology

The methodology for this study should be similar to TransCanada's water quality monitoring in 2012 including weekly vertical profiles within the impoundment, weekly water quality samples of nutrients and chlorophyll-a for laboratory analysis and the deployment of multi-parameter continuous dataloggers at multiple locations within the impoundment, tailrace and bypass reach. An additional site should be monitored in the 17 mile free flowing section of the river above the impoundment to serve as a "reference site". At each designated datalogger monitoring location at least 10 days of data should be collected at 15 minute increments during a period of low flow ($\leq$3 x 7Q10) and high temperatures (preferably over 23 degrees C) between June 1 and September 30. Dataloggers deployed in the impoundment should be set at the bottom of the epilimnion (if stratified) or at 25% depth if not stratified. A vertical dissolved oxygen and water temperature profile should be conducted at the time of deployment of dataloggers in the impounded section to determine if river is stratified and thus the appropriate depth for deployment. Dataloggers equipped with turbidity probes should be deployed at locations up and downstream of the dam for several months to help document the effects of peaking operations on bank erosion. Placement of dataloggers with turbidity probes should be coordinated with other studies regarding erosion. Water quality results should be graphically compared to both state water quality standards and project operations, including the generation status, impoundment elevation, and discharge.

If low flow conditions are not met the first year of the study, a second year of data may be necessary.

It is preferable that the water quality monitoring for all projects be coordinated so that sampling can occur at each location within each project during the same period of time and under the same operational, flow, and environmental conditions.

Level of Effort and Cost

The cost and effort of this study will be moderate, but is important to document the potential impact operations have on water quality and determine if they meet Vermont and New Hampshire water quality standards.

Study Request 25c: Vernon Hydroelectric Project: Water quality monitoring within the Vernon project impoundment and tailrace and in the Turner Falls Impoundment in New Hampshire (FERC NOs. 1904 and 1889)

Goal and Objective

The goal of this study is to determine if the operational impacts of at the Vernon and Turners Falls Projects are causing or contributing to violations of New Hampshire and/or Vermont state water quality standards.

The objective of this study will be to collect water temperature, dissolved oxygen, specific conductance, pH, turbidity, nutrients, and chlorophyll-a data at multiple locations in the project area. This monitoring effort will consist of both instantaneous measurements and continuous data collected via multi-parameter dataloggers. Data should be collected under normal and peak operating conditions and ambient conditions that include periods of low flow and higher water temperatures. Turbidity readings can provide an approximation of the total suspended solids concentration and therefore of erosion due to peaking operations. Dataloggers equipped with turbidity probes should be deployed at locations up and downstream of the dam to help document the effects of peaking operations on bank erosion and should be coordinated with other study requests regarding bank erosion. Weekly profiles and grab samples should reflect various flow conditions. The water quality data will be compared to both Vermont and New Hampshire water quality standards to determine if the project is causing or contributing to water quality standard violations.

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)].

New Hampshire surface water criteria for Biological and Aquatic Community Integrity, Env-Wq 1703.01 states the following:

> (a) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

New Hampshire surface water criteria for turbidity are provided in Env-Wq 1703.11.

This study request will inform the 401 water quality certification process and help ensure that State water quality standards will be met.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Vermont lists the section of the Connecticut River below the Wilder dam on the Section 303(d) impaired water list due to flow alterations aquatic life and habitat.

All sections of the Connecticut River related to the project are classified by New Hampshire as Class B. It should be noted that although the classification name is the same as Vermont's, New Hampshire surface water criteria for Class B waters, are in some cases, different from Vermont's.

Public Interest Consideration

The requestor is a state natural resource agency.

Existing Information

The Vernon PAD contains information on water quality monitoring that was completed between June 20, 2012 and September 11, 2012 in the tailrace and just upstream of the dam. Temperature data indicated that it reached levels that would be critical threshold for salmonids, and above the natural regime for the river. The PAD does not provide information on the water quality throughout the impoundment or how water quality is affected by project operations. The PAD does indicates that in general temperature, specific conductance, and pH did increase from upstream to downstream while dissolved oxygen decreased, reflecting the impacts of the impoundment on increased travel time in the river. The Turners Falls PAD references monitoring conducted in 2004 by DES which was not that comprehensive. More recent data is needed in the Turners Falls impoundment that is collected in the same manner and during the same time period as the Vernon Project. To our knowledge, no turbidity data has been collected for either project.

Project Nexus

The Vernon project impounds 26 miles of river that would otherwise be natural free-flowing. It currently operates in a peaking mode, with allowable impoundment fluctuations of up to 8 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1250 cfs). The impoundment for the Turners Falls impoundment extends approximately 5.7 miles into New Hampshire. It also operates in a peaking mode, with allowable impoundment fluctuations of up to 9 feet. Water quality can be affected by the operating mode of a hydropower project. The PAD provides limited information on how project operations affect water quality within the project impoundment and tailrace.

Operations of the project must conform to Vermont and New Hampshire water quality standards . The Vermont Agency of Natural Resources and the New Hampshire Department of Environmental Services request a study that will provide the data needed to determine if the Connecticut River in the vicinity of the Wilder Hydroelectric Project is or is not attaining the water quality standards of both states.

Proposed Methodology

The methodology for this study should be similar to TransCanada's water quality monitoring in 2012 including weekly vertical profiles within the impoundment, weekly water quality samples of nutrients and chlorophyll-a for laboratory analysis and the deployment of multi-parameter continuous dataloggers at multiple locations within the impoundment and tailrace. An additional site should be monitored in the 17 mile free flowing section of the river above the impoundment to serve as a "reference site". At each designated datalogger monitoring location at least 10 days of data should be collected at 15 minute increments during a period of low flow ($\leq$3 x 7Q10) and high temperatures (preferably over 23 degrees C) between June 1 and September 30. Dataloggers deployed in the impoundment should be set at the bottom of the epilimnion (if stratified) or at 25% depth if not stratified. A vertical dissolved oxygen and water temperature profile should be conducted at the time of deployment of dataloggers in the impounded section to determine if river is stratified and thus the appropriate depth for deployment. Dataloggers equipped with turbidity probes should be deployed at locations up and downstream of the dam for several months to help document the effects of peaking operations on bank erosion. Placement of dataloggers with turbidity probes should be coordinated with other studies regarding erosion. Water quality results should be graphically compared to both state water quality standards and project operations, including the generation status, impoundment elevation, and discharge.

If low flow conditions are not met the first year of the study, a second year of data may be necessary.

It is preferable that the water quality monitoring for all projects be coordinated so that sampling can occur at each location within each project during the same period of time and under the same operational, flow, and environmental conditions.

Level of Effort and Cost

The cost and effort of this study will be moderate, but is important to document the potential impact operations have on water quality and determine if they meet Vermont and New Hampshire water quality standards.

Study Request 26: Impact of Vernon Project Operations on Downstream Migration of Juvenile American Shad (FERC NO. 1904)

Conduct a field study of juvenile American shad outmigration at the Vernon Dam to determine if project operations negatively impact juvenile shad survival and production.

Goals and Objectives

Determine if project operations affect juvenile American shad outmigration survival, recruitment, and production. The following objectives will address this request:

- Assess project operation effects of Vernon Dam on the timing, routes, migration rates, and survival of juvenile shad;
- Determine the proportion of juvenile shad that as a downstream passage route choose or are directed to existing downstream bypass structures, gate structures, or are entrained into the station turbines and assess delay, survival, timing, and related impacts with these locations under a full range of operational conditions, over the period of outmigration;
- Determine survival rates for juvenile shad entrained into Vernon Station units.
-

If it is determined that the project operations or related effects are adversely affecting juvenile shad survival, migration timing, or other deleterious population effects are noted, identify operational solutions or other solutions that will reduce and minimize impacts, within the project affected area. This study will require two years of field data to capture inter-annual variability of river discharge, water temperature, and variability in run size and juvenile production (and timing of developmental stages) and variability in outmigration timing which may relate to spring, summer and fall conditions.

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)].

New Hampshire surface water criteria for Biological and Aquatic Community Integrity, Env-Wq 1703.01 states the following:

(a) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region. Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

This study request will inform the 401 water quality certification process and help ensure that State water quality standards, such as Env-Wq 1703.01, will be met.

The Connecticut River Atlantic Salmon Commission developed *A Management Plan for American Shad in the Connecticut River* in 1992. Management Objectives in the plan include the following:

1. Achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually.
2. Maximize outmigrant survival for juvenile and spent adult shad.

The Atlantic States Marine Fisheries Commission Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management), approved in 2010 includes the following objective:

1. Maximize the number of juvenile recruits emigrating from freshwater stock complexes.

The New Hampshire Fish and Game Department (NHFGD) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:
1) Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2) Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to American shad, the NHFGD's goals are:
1. Minimize current and potential negative project operation effects on juvenile American shad survival, production, and recruitment.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1) New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2) New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3) New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The requestor is a state natural resource agency.

Existing Information

Adult shad are counted annually as they pass the Vernon Dam. Juvenile American shad production has been monitored upstream of the Vernon Dam and immediately downstream of that dam by Vermont Yankee Nuclear as part of an annual monitoring program using both boat electrofishing (since 1991) and beach seining (since 2000). A seasonal average annual index of juvenile American shad standing crop in Vernon reservoir has been calculated since 2000. Estimates of juvenile shad growth rates in the Vernon impoundment have been calculated annually beginning in 2004, and also in a study conducted in 1995 (Smith and Downey 1995).

Although there were numerous studies of downstream passage facilities at the Vernon Project for Atlantic salmon smolts, passage studies for American shad were limited to tests in 1991 and 1992 of a high frequency sound field to guide fish to the fish pipe, the primary downstream fishway (RMC 1993). Although the studies were deemed incomplete, the technology indicated some level of response by juvenile shad. However, despite that conclusion, there is no indication that this technology or other downstream passage studies with juvenile shad were subsequently pursued.

Nexus to Project Operations and Effects

Juvenile American shad production occurs in the river reach between the Vernon Dam and the Bellows Falls Dam, which is thought to be the historic upstream limit of the shad migration in the Connecticut River. Juvenile American shad require safe and timely downstream passage measures to have the opportunity to contribute to the restoration target population size.

There is little information available regarding the total impact of the Vernon project on downstream migration of juvenile shad. Migration delays, increased predation, mortality during passage over the dam or through turbines, and changes in route selection under different flow conditions are potential influences of the Vernon Dam on the juvenile shad population in the upper Connecticut River. Effective upstream and downstream passage and successful in-river spawning and juvenile production are necessary to help achieve shad management restoration goals for the Connecticut River, particularly in the upstream reaches. Delays in juvenile American shad outmigration may affect survival rates in the transition to the marine environment (Zydlewski et al. 2003).

Methodology Consistent with Accepted Practice

The impact to juvenile shad outmigrants would be best studied by a combination of approaches including hydroacoustics, radio telemetry (including passive integrated transponder (PIT) telemetry), and turbine balloon tags. Project discharge adjustments at the dam should be examined relative to timing, duration, and magnitude of juvenile shad migration to and through the dam, with hydroacoustic equipment for natural/wild fish information. In addition, study fish should be collected and tagged (PIT, radio, balloon) to then empirically determine rates of survival for fish passed through the project under varied operations, from minimum flows up to full spill conditions. The release of tagged fish (radio, PIT) at a number of potential sites will provide data on delay and route selection as juvenile shad move through the Vernon project area. The number and location of release sites will depend on the availability of tagged fish.

Additional hydroacoustic assessment immediately upstream and downstream of the Vernon Dam will provide information on the timing of migration to and through this area. A more focused survival study, using balloon tags, PIT tags, or other appropriate methods, should be conducted in the second year based upon the first year of study findings relative to the frequency, magnitude, timing, and route selection of juvenile American shad through the Vernon project.

Level of Effort/Cost, and Why Alternative Studies will not suffice

TransCanada does not propose any studies to meet this need. Estimated cost for the study is expected to be high with the majority of costs associated with equipment (hydroacoustic gear, radio tags, radio receivers, and PIT readers) and related fieldwork labor.

Literature Cited:

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

RMC Environmental Services, Inc. 1993. Effect of ensonification on juvenile American shad movement and behavior at Vernon Hydroelectric Station, 1992 – Draft Report, March 1993.

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Zydlewski, J., S. D. McCormick, and J. G. Kunkel. 2003. Late migration and seawater entry is physiological disadvantageous for American shad juveniles. Journal of Fish Biology #63, 1521-1537.

Study Request 27: Climate Change as it Relates to Continued Operation of the Vernon, Bellows Falls, Wilder, Northfield Mountain Pumped Storage, and Turners Falls Projects (FERC NOs. 1904, 1855, 1892, 2485, and 1889)

Goals and Objectives

The goal of this study is to determine how climate change relates to the continued operation of the Vernon, Bellows Falls, Wilder, Northfield Mountain Pumped Storage (NFMPS), and Turners Falls projects. The NFMPS and Turners Falls projects impact the Turners Falls impoundment, a portion of which (5.7 miles) is in New Hampshire. These projects are therefore included in this request.

The objectives of this study are:

1. Quantify the amount of thermal loading contributed by each respective impoundment (including the NMPS upper reservoir).
2. Using climate change prediction models, calculate how much warmer the project impoundments are projected to get in the next 30-50 years.
3. Model the effect of various project modifications on river temperature under current conditions and climate change predictions (e.g., converting to run-of-river, deep-water releases, dam removal, large-scale riparian revegetation, etc.).
4. Using climate change prediction models, determine if the projects actually provide an environmental benefit with respect to mitigating against climate change impacts (vis a vis warming of air and water temperatures) by producing low greenhouse gas emitting energy. The Northfield Mountain Pump Storage assessment must be based on net energy production (i.e., NMPS generates1,143,038 MWh annually, but consumes 1,567,506 in its pumping operations; for a net generation of 424,468 MWh annually).
5. Determine how climate change predictions will impact management of high and low flow events at the projects and evaluate if changes to dam structures would mitigate adverse impacts of the existing flood management protocols.

Resource Management Goals

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire. Surface water quality standards include designated uses, criteria to protect the designated uses and antidegradation provisions to protect and maintain existing uses and to minimize degradation of high quality surface waters. Surface water quality standards are included in statute (RSA 485-A:8) and in the State surface water quality regulations (Env-Wq 1700). Designated uses for surface waters include aquatic life, fish consumption, shellfish consumption (tidal waters only), drinking water supply after adequate treatment, primary and secondary contact recreation and wildlife. State surface waters are classified as either class A or B [Env-Wq 1703.01(a)]. The Connecticut River in the vicinity of the hydroelectric projects is Class B. DES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env-Wq 1703.01 (b)].

New Hampshire surface water criteria for Biological and Aquatic Community Integrity, Env-Wq 1703.01 states the following:

> (a) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region. Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

Impacts of climate change on flow and temperature can impact aquatic life and other uses. This study request will inform the 401 water quality certification process and help ensure that State water quality standards, such as Env-Wq 1703.01, will be met.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures consistent with the Department's 2010-2015 Strategic Plan that was released in the fall of 2010. The Plan includes two goals and several sub-goals that relate to climate change and shifting environmental conditions in the future. Those goals and sub-goals are as follows:

N.H. Department of Environmental Services Strategic Plan (2010 - 2015)

Goal 1: DES and its partners address climate change through effective mitigation and adaptation strategies and efforts to foster the transition to a clean energy economy.

1.1 DES will work in partnership with other state agencies to institutionalize climate change mitigation and adaptation throughout state operations

1.1.1 DES will consider and integrate climate change mitigation and adaptation across all existing DES program areas. (Target: Commence in 2010, and Ongoing)

1.2 DES will work in partnership with state, regional, and national organizations to integrate and coordinate mitigation and adaptation efforts.

1.2.2 DES will continue to take part in regional and national initiatives to advance the transition to a clean energy economy. (Target: Commence by 2010, and Ongoing)

1.2.3 DES will continue to participate in regional and national initiatives to better prepare for the impacts of climate change. (Target: Commence by 2010, and Ongoing)

1.3 DES will monitor, inventory and report climate change emissions and impacts.

1.3.2 DES will work with state research universities and other institutions and organizations to track the indicators and the impacts of climate change, and to support periodic reporting to policymakers and the public. (Target: Commence in 2010, and Ongoing)

1.4 DES will conduct comprehensive mitigation and adaptation education and outreach.

1.4.3 DES will collaborate with partners to support the provision of resources for technical assistance to communities and organizations that are seeking to incorporate adaptation measures into their projects and plans. (Target: Commence in 2010, and Ongoing)

The United States. Fish and Wildlife Service (Service) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to climate change, the Service's goals are:

1. Minimize current and potential negative project operation effects that could hinder management goals and objectives.
2. Minimize deep headpond drawdowns associated with the loss of stanchion logs during high flow events, which are predicted to increase due to climate change.
3. Minimize project-related sources of thermal increases to Connecticut River waters to mitigate against predicted climate change impacts.

The Service, along with the National Oceanic and Atmospheric Administration (NOAA) and the Association of Fish and Wildlife Agencies developed a draft *National Fish, Wildlife and Plants Climate Adaptation Strategy* in 2012. The public comment period closed on March 5, 2012, and the agencies are working to finalize the document. Goal #7 of the Strategy calls for reducing non-climate stressors to help fish, wildlife, plants, and ecosystems adapt to a changing climate. The Strategy notes that some stressors (such as habitat loss and fragmentation and pollution) "are not only some of the things decision makers can control, they are also likely to interact with climate change to magnify negative impacts on fish, wildlife, and plants."

Goal #7 contains a number of strategies and associated actions, including:
Strategy 7.1: Slow and reverse habitat loss and fragmentation
Actions:

- Consider application of offsite habitat banking linked to climate change habitat priorities as a tool to compensate for unavoidable onsite impacts and to promote habitat conservation or restoration in desirable locations
- Identify options for redesign and removal of existing structures/barriers where there is the greatest potential to restore natural processes.

Strategy 7.2: Slow, mitigate, and reverse where feasible ecosystem degradation from anthropogenic sources through…water resource planning, pollution abatement…
Actions:

- Work with ….water resource…planners to identify potentially conflicting needs and opportunities to minimize ecosystem degradation resulting from development and land and water use.
- Reduce existing pollution and contaminants and increase monitoring of air and water pollution.
- Increase restoration, enhancement, and conservation of riparian zones and buffers in agricultural and urban areas to minimize non-point source pollution.

This study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq*.), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq*.), and the Federal Power Act (16 U.S.C. §791a, *et seq*.).

Public Interest

The requester is a state natural resource agency.

Existing Information

The PADs contains no information relative to climate change and how climate change predictions may impact future operation of the hydroelectric plants, nor of how the projects either mitigate for or exacerbate predicted climate change impacts to freshwater ecosystems.

TransCanada's PADs provide a summary of water quality data collected in 2012. Table 1 below is a synthesis of the temperature data collected by TransCanada. It should be noted that the upper and mid-impoundment stations at each project represent the average of temperature readings taken over the entire water column, while the continuous loggers (Lower Cont. and TR) were located near the water surface. These data indicate that from the upstream end of the Wilder headpond to the Vernon tailrace, water temperature increased approximately 6°C.

Table 1. Median water temperature at monitoring stations located within the impoundments and tailraces of the threehydropower projects.

	Median Water Temperature °C			
Project	Upper Imp.	Mid-Imp.	Lower Cont.	TR
Wilder	20.86	21.83	24.08	23.59
BF	22.43	23.67	24.86	24.38
Vernon	23.81	24.49	26.73	26.35

Relative to existing flood management protocols at each station, TransCanada's PADs identify that all three dams utilize stanchion bays (two at Vernon, three at Bellows Falls, and four at Wilder). When inflows to each dam reach certain levels, the stanchion bays are removed, and cannot be replaced until inflows subside. The depth of these bays and the flows they are removed at are outlined in Table 2, below.

Table 2. Summary of pertinent stanchion bay. Information for the Vernon, Bellows Falls, and Wilder projects.

Project	Stanchion Height (feet)	Flow Triggering Complete Stanchion Removal
Wilder	17	145,000 cfs
BF	13	50,000 cfs
Vernon	10	105,000 cfs

The PADs provide no information on the history of stanchion removal at any of the projects (frequency, duration, timing), nor a discussion of how predicted climate change might alter management of the stanchion bays in the future (with respect to the frequency and seasonality of occurrence). There also is no discussion of potential impacts to headpond resources that occurs as a result of stanchion bay removal. These information gaps need to be filled so resource agencies can assess the relative and cumulative impact of project operations with respect to the Service's management goals and objectives, including those identified in the Climate Adaptation Strategy document.

Data provided by the National Oceanic and Atmospheric Administration, Climate Data Center, illustrates long-term increasing air temperatures in the Northeast (Figure 1). Long-term, monthly mean water temperature data for the Vernon Dam impoundment, monitored by Vermont Yankee, has shown significant differences over time (ANOVA analyses, $P < 0.05$) that when plotted and further analyzed by linear regression, show a significant increasing trend for the period 1974 – 2011 for the months of January, September, and October (Figure 2). These analyses were performed with data from Vermont Yankee, analyzed by the Massachusetts Department of Environmental Protection.

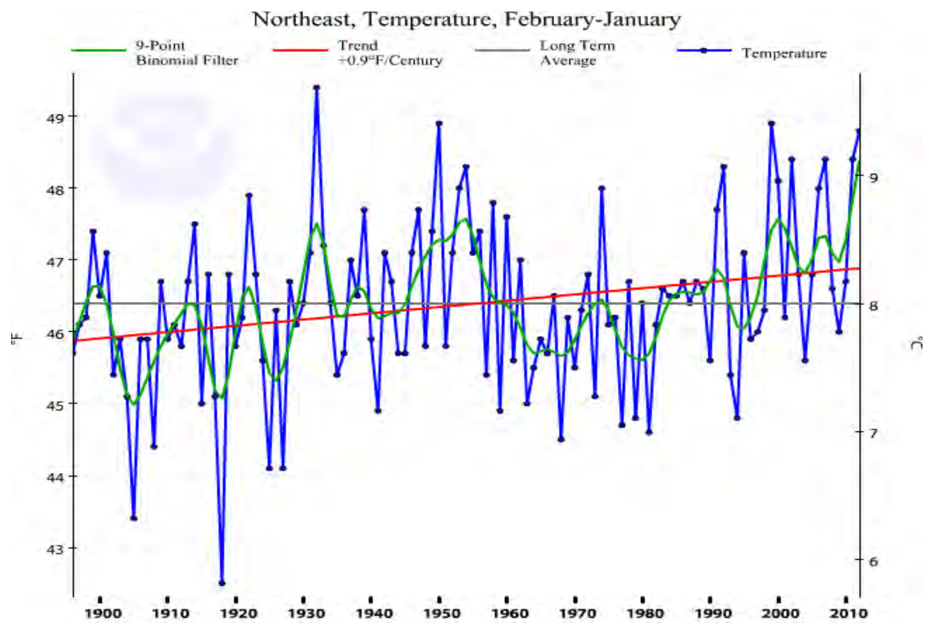

Figure 1. NOAA National Climate Data Center, Northeast 12-month average temperature for the period 1896 through 2012 (October).

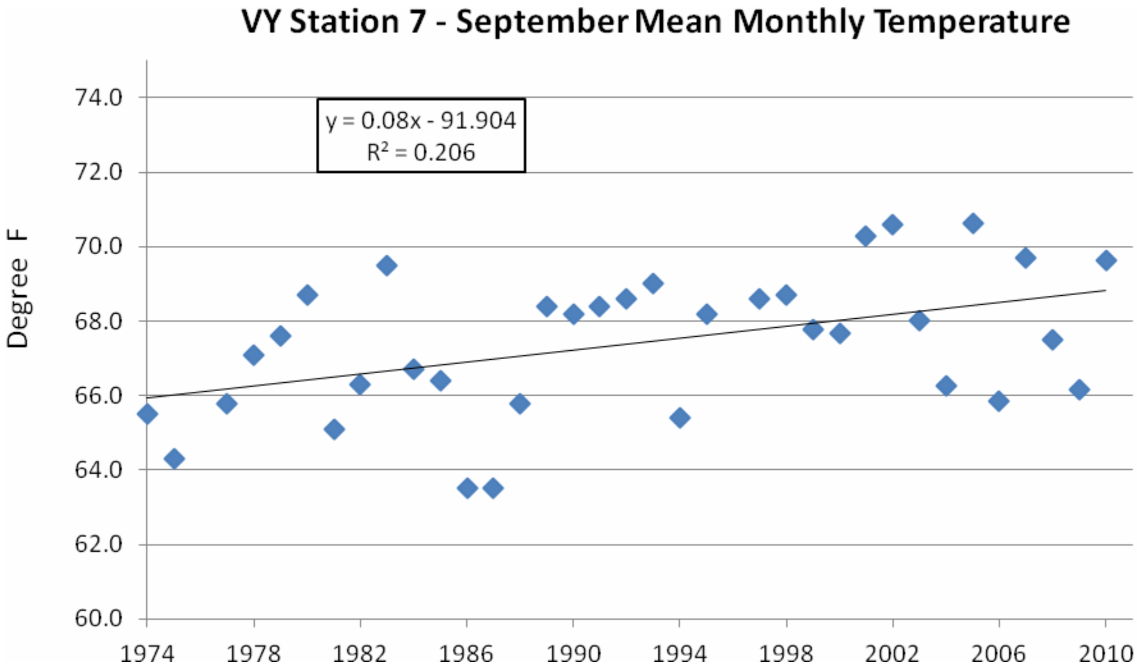

Figure 2. A plot of September's mean temperatures for Vermont Yankees' Station 7 (excludes outlier 1996 data point) for the period 1974 through 2011.

The PAD for Turners Falls and Northfield Mountain Pump Storage projects provides a summary of existing water quality data compiled by FirstLight, including water temperature data obtained from the Service. The PAD also notes a 1991 study by the former licensee that modeled thermal effects of pumping to the upper reservoir. That model reported a maximum temperature difference attributable to NMPS operation of 0.21°C in the Turners Falls reach of the Connecticut River in low flow (4,000 CFS) simulation.

Nexus to Project Operations and Effects

The four mainstem projects have very long impoundments capable of storing large volumes of water (Table 3, below). These impoundments effectively have converted large portions of the Connecticut River into a series of in-river "lakes." Because water velocities slow in these impounded sections of river, it allows for increased thermal loading and resultant higher water surface temperatures than in free-flowing sections of river.

Table 3. Relevant characteristics of the reservoirs behind the Wilder, Bellows Falls, Vernon, Turners Falls dams and NMPS.

Project	Headpond Length (miles)	Gross Storage Volume (acre-ft.)	Average Depth (ft.)	Surface Area (acres)	Flushing Rate (days)
Wilder	45	34,350	11	3,100	3
BF	26	26,900	10	2,804	<2
Vernon	26	40,000	16	2,550	2
Turners	20	21,500		2,110	
NMPS	n.a.	17,,050		246	n.a.

Depending on where the hydropower intakes withdraw water, these warmer surface waters may be discharged downstream, raising the temperature of those waters as well (the data in Table 1 above suggest that the projects do draw water from the upper levels of the reservoirs). This effect may be felt for miles downstream. If there are a series of impoundments (like on the Connecticut River), the cumulative impact is an overall warming of the river. Even small run-of-river dams have been shown to elevate downstream water temperature (Lessard and Hayes 2003; Saila et al. 2005). The most recent climate change prediction models specific to the northeast forecast warmer air temperatures, more frequent high precipitation events, more heat waves, and an increase in the incidence of short term droughts (Karl et al. 2009).

Resource concerns related to this project effect include the potential impacts to populations (reductions in abundance, structure, condition) or loss of species not tolerant of increases in temperature and other effects related to physiology such as energetic costs with warmer temperatures (Leggett 2004). As one example, American shad restoration target numbers for fish passage at mainstem dams into upstream historic habitat could be negatively impacted from artificially increased water temperatures. Water temperature has been identified as a factor in the timing (i.e., duration) of this species migration, as well as its role in gonad development and spawning (Glebe and Leggett 1981; Leggett 2004). These factors can be logical reasoned to potentially result in accelerated rates of energy reserve use and a reduced migration window, possibly reducing the ability of fish to reach up-river habitats and further reducing the ability to survive downstream outmigration.

With respect to project operations during high flow events, all TransCanada projects have stanchion bays that are used to manage water during high flow events. Each time these stanchion bays are removed, the headponds are lowered substantially (from 10 to 17 feet, depending on the project) and must remain lowered until inflows subside. Depending on the timing and duration of these deep drawdowns, headpond resources could be negatively impacted.

All of the dams also contain other mechanisms for managing flows, such as tainter gates, sluice gates, roller gates, skimmer gates and hydraulic flood gates. All of these gates have an advantage over stanchion bays in that they do not require flows to subside significantly before they can be closed to return impoundment levels back to normal. One climate change prediction for the northeast is that we will see more frequent high precipitation events which will result in high flow conditions on rivers. Therefore, it is likely that the stanchion bay removal protocol will have to be employed more frequently in the future.

Methodology Consistent with Accepted Practice

1. In order to quantify the amount of thermal loading contributed by each respective impoundment, detailed bathymetry will need to be collected. This bathymetry, combined with storage volume,

tributary hydrology, and project operations, should be used to calculate the thermal loading of each headpond. The individual and cumulative increase in surface water temperature due to the impoundments should then be used to predict future warming based on climate change models.
2. Analyze different mitigation strategies to understand which have the greatest benefit in terms of building resilience against the impacts of climate change on water temperature. Potential scenarios to analyze include converting the projects to run-of-river, implementing deep-water releases, removing one or more dams, conducting large-scale riparian revegetation, etc.).
3. Input to climate change models the amount of GHG emissions that would be generated if fossil fuel plants were producing the equivalent amount of net energy as the five hydropower projects to determine the impact on air and surface water temperatures.
4. Climate change prediction model output should be assessed to determine if the frequency and timing of high flow events is likely to change in the future. If high flow events that necessitate initiating the stanchion bay removal protocol are predicted to increase in frequency and/or shift in timing, the applicant should evaluate structural and/or operational alternatives that would mitigate adverse impacts of the existing flood management protocols.

Level of Effort/Cost, and Why Alternative Studies will not suffice

The level of cost and effort for the thermal loading analysis would be low to moderate. Collecting bathymetry in the three TransCanada headponds would take two staff less than one week to collect (it took the Kansas Biological Survey two days to collect bathymetry at a 3,500 acre lake; Jakubauskas et al. 2011). Bathymetry for the Turners Falls pool and NMPS upper reservoir already exist. The remaining work would be desk-based; loading relevant information into an appropriate thermal loading model to compute the estimated thermal loading of each headpond and then comparing this information to surface water data from climate change prediction models.

The high flow flood protocol study is a desktop analysis that should require low cost and effort. Climate change models already exist and that output would be downloaded and analyzed. The remaining analysis requires a review of alternative means of managing flows without the use of stanchion bays.

The applicants did not propose any studies to meet this need in the PAD.

Literature Cited:

Jakubauskas, M., J. deNoyelles, E. A. Martinko. 2011. Bathymetric and Sediment Survey of Elk City Reservoir, Montgomery County, Kansas. Applied Science and Technology for Reservoir Assessment (ASTRA) Program, Lawrence, KS. Report No. 2010-01

Glebe, B. D. and W. C. Leggett. 1981. Latitudinal differences in energy allocation and use during the freshwater migration of American shad and their life history consequences. Canadian Journal of Fisheries and Aquatic Sciences 38, 806-820

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Lessard, J.L. and D.B. Hayes. 2003. Effects of elevated water temperature on fish and Macroinvertebrate communities below small dams. River Research and Applications.

Saila, S.B., Poyer, D., and D. Aube. 2005. Small dams and habitat quality in low order streams. Wood-Pawcatuck Watershed Association. April 29, 2005. 16 pp.

Stier, D. J. and J. H. Crance. 1985. Habitat suitability index models and instream flow suitability curves: American shad. U. S. Fish and Wildlife Service Biological Report No. 82 (10.88), Washington D.C.

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Glenn Normandeau
Executive Director

February 27, 2013

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E., Room 1A
Washington, DC 20426

RE: Study Requests for FERC project numbers P-1904 (Vernon), P-1855 (Bellows Falls), and P-1892 (Wilder).

Dear Secretary Bose:

As the agency responsible for protecting fish and wildlife resources in New Hampshire, the New Hampshire Fish and Game Department (NHFGD) monitors and attempts to reduce the impacts of hydroelectric facilities on fish and wildlife species and their habitats. The mission of the New Hampshire Fish and Game Department (NHFGD) is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources. The NHFGD's 1998-2010 Strategic Plan contains four goals relevant to the relicensing process under the Federal Energy Regulatory Commission (FERC). These goals are to ensure that New Hampshire:

1) has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.

2) has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.

3) has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.

4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Participation in the relicensing process for hydroelectric projects falls under one of the many strategies outlined in New Hampshire's Wildlife Action Plan. Wildlife Action Plans, completed in 2005, were required from each state by the United States Congress as a proactive strategy to "conserve wildlife and vital natural areas before they become more rare and more costly to protect". New Hampshire's Wildlife Action Plan contains three objectives relevant to the hydropower relicensing process.

Objective 507: Restore or maintain natural flow regimes.
Objective 508: Restore and maintain watershed continuity.
Objective 701: Protect riparian / shoreland habitat and other wildlife corridors.

In addition to these objectives, the New Hampshire Wildlife Action Plan identifies a number of fish and wildlife species of concern, which may be impacted by the projects under review. We hereby submit the New Hampshire Wildlife Action Plan to the FERC for consideration in determining whether it qualifies as comprehensive plans pursuant to Section 10(a)(2)(A) of the Federal Power Act. The complete New Hampshire Wildlife Action Plan is available online at: http://www.wildlife.state.nh.us/Wildlife/wildlife_plan.htm.

The NHFGD has reviewed the Preliminary Application Documents and Scoping Documents for the relicensing of the following hydropower projects owned by TransCanada Corporation:

Vernon Hydroelectric Project
FERC Project No. 1904

Bellows Falls Hydroelectric Project
FERC Project No. 1855

Wilder Hydroelectric Project
FERC Project No. 1892

The NHFGD submits the following formal study requests to expand on the information presented in each Pre-Application Document (PAD) and lead to informed management decisions intended to reduce impacts on fish and wildlife. It is understood that there is overlap between some of the requested studies, and where appropriate, the NHFGD supports the combination of studies to reduce cost and effort as long as the goals and objectives within each individual study proposal are still achieved.

Thank you for this opportunity to comment.

Sincerely,

Glenn Normandeau
Executive Director

Study Request 1a: Recreational Survey and Enhancement Study at Wilder Hydroelectric Project (Docket Number p-1892)

Goal and Objective

The goal of this study is to determine if potential impacts from project operations at the Wilder Hydroelectric facility support the goals of the NH Fish and Game Departments' Public Boating Access program and the Vermont Water Quality Standards for recreational uses, and to identify operational modifications that could be performed to enhance recreational opportunities.

The objectives are to:

Survey recreational users and potential users to identify to what extent existing recreational opportunities are being utilized by the public within the project boundaries and why potential recreational users are not using the resource.

Identify how project operations impact recreational users and how operations could be modified to improve recreational opportunities.

Identify how recreational opportunities in the vicinity of the project could be developed to enhance future recreational opportunities, including, but not limited to, boat access, primitive camping sites, improvement in portage trails, etc.

Resource Management Goals

The Connecticut River is considered a Class B waters. Vermont Water Quality Standards requires that Class B waters be managed to provide full support for all recreational uses, including swimming and other primary contact forms of recreation and boating, fishing and other recreational uses.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998); which are relevant to this study request are:

5) New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
6) New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
7) New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
8) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest Consideration

The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

Existing Information

The PAD provides information on the existing recreational resources, but does not provide information on how project operations adversely affect recreational opportunities or perception of recreational users utilizing opportunities in the vicinity of the project.

Project Nexus

The project impounds 45 miles of river that would otherwise be free flowing. The project currently operates in a peaking mode, with allowable impoundment fluctuations of up to 5 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (675 cfs), but can increase rapidly during times of power generation. Recreational resources and opportunities can be affected by the operations of the hydropower project. The PAD provides limited information on how project operations affect recreational users and opportunities within the project impoundment and tailrace. The NHFGD requests a study to assess how recreational opportunities are impacted by normal daily/seasonal operation of the project.

Proposed Methodology

The proposed study methodology should include an inventory of all the recreational facilities and opportunities within the project boundary, and a determination of the number of recreational users utilizing the resources. The study should include a component to survey an equal proportion of recreational users utilizing different activities to determine how project operations affect their recreational use and experience, and identify any safety issues associated with project operations or current recreational facilities. Potential recreational users in the area should be identified to determine why potential recreational users do not use the resource. An analysis of the recreational facilities should be conducted to identify future projects that could improve the recreational resources and/or the need to improve existing recreational facilities or access to the resource.

Level of Cost and Effort

The cost and effort of this study will be moderate, but is important to document the potential impact operations on recreational opportunities. This study will also identify opportunities for future enhancement of recreational resources in the vicinity of the project.

Literature Cited:

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010), Concord, NH.

Study Request 1b: Recreational Survey and Enhancement Study at Bellows Falls Hydroelectric Project (Docket Number p-1855)

Goal and Objective

The goal of this study is to determine if potential impacts from project operations at the Bellows Falls Hydroelectric facility support the goals of the NH Fish and Game Departments' Public Boating Access program and the Vermont Water Quality Standards for recreational uses, and to identify operational modifications that could be performed to enhance recreational opportunities.

The objectives are to:

Survey recreational users and potential users to identify to what extent existing recreational opportunities are being utilized by the public within the project boundaries and why potential recreational users are not using the resource.

Identify how project operations impact recreational users and how operations could be modified to improve recreational opportunities.

Identify how recreational opportunities in the vicinity of the project could be developed to enhance future recreational opportunities, including, but not limited to, boat access, primitive camping sites, improvement in portage trails, etc.

Resource Management Goals

The Connecticut River is considered a Class B waters. Vermont Water Quality Standards requires that Class B waters be managed to provide full support for all recreational uses, including swimming and other primary contact forms of recreation and boating, fishing and other recreational uses.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998), which are relevant to this study request are:

1) New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2) New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3) New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest Consideration

The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

Existing Information

The PAD provides information on the existing recreational resources, but does not provide information on how project operations adversely affect recreational opportunities or perception of recreational users utilizing opportunities in the vicinity of the project.

Project Nexus

The project impounds 26 miles of river that would otherwise be free flowing. The project currently operates in a peaking mode, with allowable impoundment fluctuations of up to 3 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1083 cfs), but can increase rapidly during times of power generation. Recreational resources and opportunities can be affected by the operations of the hydropower project. The PAD provides limited information on how project operations affect recreational users and opportunities within the project impoundment and tailrace. The NHFGD requests a study to assess how recreational opportunities are impacted by normal daily/seasonal operation of the project.

Proposed Methodology

The proposed study methodology should include an inventory of all the recreational facilities and opportunities within the project boundary, and a determination of the number of recreational users utilizing the resources. The study should include a component to survey an equal proportion of recreational users utilizing different activities to determine how project operations affect their recreational use and experience, and identify any safety issues associated with project operations or current recreational facilities. Potential recreational users in the area should be identified to determine why potential recreational users do not use the resource. An analysis of the recreational facilities should be conducted to identify future projects that could improve the recreational resources and/or the need to improve existing recreational facilities or access to the resource.

Level of Cost and Effort

The cost and effort of this study will be moderate, but is important to document the potential impact operations on recreational opportunities. This study will also identify opportunities for future enhancement of recreational resources in the vicinity of the project.

Literature Cited:

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 1c: Recreational Survey and Enhancement Study at Vernon Hydroelectric Project (Docket Number p-1904)

Goal and Objective

The goal of this study is to determine if potential impacts from project operations at the Vernon Hydroelectric facility support the goals of the NH Fish and Game Departments' Public Boating Access program and the Vermont Water Quality Standards for recreational uses, and to identify operational modifications that could be performed to enhance recreational opportunities.

The objectives are to:

Survey recreational users and potential users to identify to what extent existing recreational opportunities are being utilized by the public within the project boundaries and why potential recreational users are not using the resource.

Identify how project operations impact recreational users and how operations could be modified to improve recreational opportunities.

Identify how recreational opportunities in the vicinity of the project could be developed to enhance future recreational opportunities, including, but not limited to, boat access, primitive camping sites, improvement in portage trails, etc.

Resource Management Goals

The Connecticut River is considered a Class B waters. Vermont Water Quality Standards requires that Class B waters be managed to provide full support for all recreational uses, including swimming and other primary contact forms of recreation and boating, fishing and other recreational uses.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998), which are relevant to this study request are:

1) New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2) New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3) New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.

4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest Consideration

The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

Existing Information

The PAD provides information on the existing recreational resources, but does not provide information on how project operations adversely affect recreational opportunities or perception of recreational users utilizing opportunities in the vicinity of the project.

Project Nexus

The project impounds 26 miles of river that would otherwise be free flowing. The project currently operates in a peaking mode, with allowable impoundment fluctuations of up to 8 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1250 cfs), but can increase rapidly during times of power generation. Recreational resources and opportunities can be affected by the operations of the hydropower project. The PAD provides limited information on how project operations affect recreational users and opportunities within the project impoundment and tailrace. The NHFGD requests a study to assess how recreational opportunities are impacted by normal daily/seasonal operation of the project.

Proposed Methodology

The proposed study methodology should include an inventory of all the recreational facilities and opportunities within the project boundary, and a determination of the number of recreational users utilizing the resources. The study should include a component to survey an equal proportion of recreational users utilizing different activities to determine how project operations affect their recreational use and experience, and identify any safety issues associated with project operations or current recreational facilities. Potential recreational users in the area should be identified to determine why potential recreational users do not use the resource. An analysis of the recreational facilities should be conducted to identify future projects that could improve the recreational resources and/or the need to improve existing recreational facilities or access to the resource.

Level of Cost and Effort

The cost and effort of this study will be moderate, but is important to document the potential impact operations on recreational opportunities. This study will also identify opportunities for future enhancement of recreational resources in the vicinity of the project.

Literature Cited:

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 2: Telemetry Study of Upstream and Downstream Migrating Adult American Shad to Assess Passage Routes, Effectiveness, Delays, and Survival (Docket Number p-1904)

Goals and Objectives

Assess behavior, approach routes, passage success, survival, and delay by adult American shad as they encounter the projects during both upstream and downstream migrations, under permitted project operations conditions, proposed operational conditions, and study treatment operational conditions at First Light Power's Turners Falls and Northfield Mountain Pumped Storage projects and TransCanada's Vernon Project. There are multiple fishways and issues related to both upstream and downstream passage success at the projects. Some of these issues at the Turners Falls Project are similar to and/or pertain directly to the Northfield Mountain and Vernon projects. Therefore, it is reasonable to address passage issues at all projects in a similar manner.

Telemetry Study - This requested study requires use of radio telemetry using both radio and Passive Integrated Transponder (PIT) tag types to provide information to address multiple upstream and downstream fish passage issues. The following objectives shall be addressed in these studies:

- Assessment of any migration delays resulting from the presence of the dam and peaking flow operations of the Turners Falls Project;
- Determine route selection and behavior of upstream migrating shad at the Turners Falls Project under various spill flow levels (e.g., movement to the dam, attraction to Cabot Station, attraction to Station 1 discharge, movement between locations, delay, timing, etc.). A plan and schedule for dam spill flow releases will need to be developed that provides sufficient periods of spill flow conditions, and various generating levels from Turners #1 Station coupled with Cabot Station generation flows (e.g., treatments will require multiple days of consistent discharge). Evaluated spill flows should include flows between 2,500 – 6,300 cfs, which relate to bypass flows identified as providing spawning opportunities for shortnose sturgeon in the lower bypass reach at the Rock Dam. (Kieffer and Kynard 2012). Sturgeon spawning and upstream shad passage occur concurrently;
- Assess near field, attraction to and entrance efficiency of the Spillway Ladder by shad reaching the dam spillway, under a range of spill conditions;
- Evaluate the internal efficiency of the Turners Falls Spillway Ladder;
- Continue data collection of Cabot Station Ladder and Gatehouse Ladder efficiency, to include rates of approach to fishway entrances, entry into fishways, and passage through them, under different operational conditions that occur in these areas;
- Evaluate modifications to the Cabot and/or Spillway fishways recommended by the Service if they are implemented;
- Assess upstream migration from Turners Falls to the Vernon Dam in relation to Northfield Mountain's pumping and generating operations and Vernon Project peaking generation operations. Typical existing and proposed project operation alterations should be evaluated;

- Assess near field, attraction to and entrance efficiency of the Vernon Dam Ladder;
- Assess internal efficiency of the Vernon Dam Ladder;
- Assess upstream passage past Vermont Yankee's thermal discharge (also located on the west bank of the river 0.45 mile upstream of fish ladder exit)
- Assess upstream migration from Vernon Dam in relation to the peaking generation operations of the Bellows Falls Project. Typical existing and proposed project operation alterations should be evaluated;
- Determine post-spawn downstream migration route selection, passage efficiency, delays and survival related to the Vernon Project, including evaluation of the impact of the Vermont Yankee heated water discharge plume on downstream passage route, migrant delay/timing, efficiency and survival;
- Assess impacts of Northfield Mountain operations on up- and downstream adult shad migration, including delays, entrainment, and behavioral changes and migration direction shifts under existing and proposed project operations;
- Determine downstream passage route selection, timing/delay, and survival under varied project operational flows into the power canal and spill flows at Turners Falls Dam;
- Determine downstream passage route selection, timing/delay in the canal, Cabot Station fish bypass facility effectiveness, and survival of Cabot-bypassed adult shad that enter the Turners Falls Canal system;
- Compare rates and or measures of delay, movement and survival etc., among project areas or routes utilized (e.g., spill at dam vs. power canal) under the range of permitted and proposed conditions; and
- Utilize available data sets and further analyze raw data (e.g., 2003- 2012 Conte Lab Studies) where possible to address these questions and inform power analyses and experimental design.

Information to address all of these questions would rely on the tagging of upstream migrating adult shad at Holyoke Dam and releasing them to migrate naturally from Holyoke through the Turners Falls and Vernon projects and back downstream after spawning. Additional tagged individuals would likely need to be released farther upstream (Turners Falls Canal, upstream of Turners Falls Dam, and upstream of Vernon Dam), to ensure that enough tagged individuals encounter project dams on both upstream and downstream migrations, that these individuals are exposed to a sufficient range of turbine and operational conditions to test for project effects, and to provide adequate samples sizes for statistically valid data analyses to address the many objectives listed. This study will require two years of field data collection to attempt to account for inter-annual variability in river discharge and water temperatures.

<u>Evaluation of Past Study Data</u>- In addition to collection and analysis of new telemetry data, substantial data has already been collected at Turners Falls from multiple years of passage assessments conducted for First Light by U.S. Geological Survey's Conte Anadromous Fish Research Center (Conte Lab) researchers and there are also data from the 2011 and 2012 full river study conducted by the Conte Lab that address Turners Falls, Northfield Mountain and Vernon project migration and passage questions that have not yet been analyzed. These data include several million records each year from more than 30 radio telemetry receivers deployed between Middletown, CT and Vernon Dam. This data will provide substantial information free

from the field data collection costs and therefore should be analyzed as part of this study. This data analysis should be completed in 2013 to help inform the design of subsequent field studies.

Evaluation of Methods to Get Shad Past Cabot Station for Spillway Passage at the Turners Falls Dam – The poor passage efficiency of the Cabot Ladder, the first and most used fishway encountered by shad arriving at the Turners Falls Project, and at the entrance to the Gatehouse Ladder, which all Cabot fishway-passed fish must use, has resulted in very poor overall shad passage efficiency at the project. An alternative to passing fish at the Cabot Station is to install a fish lift at the dam that would put fish directly into the Turners Falls pool, thereby eliminating problems with the Cabot Fishways, and the Gatehouse Fishway entrance and the variable passage efficiency of the Gatehouse Fishways. For this to be effective, attraction of shad to the Cabot Station discharge and associated delays would need to be overcome. It is possible that spillway flow releases coupled with behavioral measures at Cabot Station that dissuade shad from that tailrace could achieve this end. In order to assess the possibilities, we recommend the following study:

1. A literature search and desk-top assessment of the possible behavioral measures that could be effective in getting shad to pass Cabot Station tailrace and continue upstream to the dam.

2. Based on results of the desk-top assessment, possible evaluation of behavioral measures that are likely to be effective.

3. Field evaluation of the effect of different levels of spill at the dam that would induce fish to move past the Cabot Station into the bypass reach and up to the dam (as noted in objectives).

Besides passage success and delays at passage facilities, these studies would assess the impacts of project operations on migration passage delay, route, timing, injury, mortality, and passage structure attraction, retention, and success. Of particular interest will be fish behavior during periods when flow releases from the project increase from the required minimum flows to peak generation flows and when flows subside from peak generation flows to minimum flows and the operation of NMPS in pumping and generation modes.

Resource Management Goals

The Connecticut River Atlantic Salmon Commission (CRASC) developed *A Management Plan for American Shad in the Connecticut River* in 1992. Management Objectives in the plan include the following

1. Achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually. (Table 1)

2. Achieve annual passage of 40 to 60% of the spawning run (based on a 5-year running average) at each successive upstream barrier on the Connecticut River mainstem.

3. Maximize outmigrant survival for juvenile and spent adult shad.

The Atlantic States Marine Fisheries Commission, Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management), approved in 2010 includes the following objective:

1. Maximize the number of juvenile recruits emigrating from freshwater stock complexes and recommendations:

Upstream Passage –

1. American shad must be able to locate, enter, and pass the passage facility with little effort and without stress.
2. Where appropriate, improve upstream fish passage effectiveness through operational or structural modifications at impediments to migration.
3. Fish that have ascended the passage facility should be guided/routed to an appropriate area so that they can continue upstream migration, and avoid being swept back downstream below the obstruction.

Downstream Passage –

4. To enhance survival at dams during emigration, evaluate survival of post spawning and juvenile fish passed via each route (e.g., turbines,, spillage, bypass facilities, or a combination of the three) at any given facility, and implement measures to pass fish via the route with the least delay and best survival rate.

Based on the CRASC plan, the New Hampshire Fish and Game Department (NHFGD) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to American shad movement and migration, the NHFGD's goals are:

1. Minimize current and potential negative project operation effects such as migration delays, false attraction, turbine entrainment, survival of project passage routes, and trashrack impingement that could hinder management goals and objectives.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1) New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2) New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.

3) New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

This study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The New Hampshire Fish and Game Department is requesting this study, in order to collect information holistically for the Connecticut River. Impacts associated with the operation of all the dams, both lower and upper on the Connecticut River, does contribute to the success of the State's management goals for fish and wildlife in New Hampshire. The requestor is a state natural resource agency.

Existing Information

Passage of adult shad at the Turners Falls fishway complex has been the subject of intense study by the Conte Lab since before 1999. These studies have clearly demonstrated that passage through the existing fishways at Cabot and Spillway is poor (<10% in many years). Passage through the Gatehouse fishway is better, but still rarely exceeds 80%, despite the short length of this ladder. In addition to poor passage for fish entering the ladders, shad that ascend the Cabot Fishway experience extensive delays before entry into the Gatehouse Fishway. Shad that ascend Spillway frequently fall back into the canal and are also subject to these upstream delays. A new entrance to the Gatehouse Fishway installed in 2007 led to dramatic improvements in passage out of the canal (from 5% to over 50% in 2011), but passage still falls well short of management goals. In addition, shad spend considerable time (up to several weeks) attempting to pass. These delays likely influence spawning success and survival. Adult shad, unable to pass Gatehouse, experience similar delays in downstream passage, even after they have stopped trying to pass Gatehouse. Without spill, all outmigrating shad that have passed Gatehouse must enter the canal at the Gatehouse and may be subject to delays exiting the canal.

During the course of these studies a very large dataset has been compiled that could yield useful information for further improving passage of shad out of the canal in both the upstream and downstream directions. A unique feature of these data is a 2-dimensional array covering the canal just downstream of Gatehouse, documenting fine scale movements and occupancy of this zone. These data should be combined with computational fluid dynamics (CFD) and real-time hydraulic data to determine how canal hydraulics influence the ability of shad to locate and enter the fishway, and to identify modifications that are likely to lead to improvements in approach and entry rates. A separate CFD modeling study is requested that includes modeling of the Gatehouse Fishway entrance are at the head of the power canal.

In addition, whole-river shad telemetry studies performed in 2011 and 2012 will likely provide useful information and should be analyzed. These data should allow quantification of delay below Turners Falls, and could help guide studies requested above. Preliminary analyses of data through 2011 have been made available to FirstLight and the resource agencies (Castro-Santos and Haro 2005; Castro-Santos and Haro 2010).

The whole-river studies have also shown that, at least in 2011, most shad that pass Turners Falls rapidly progress upstream to Vernon Dam where extensive delays also occur. Data from the 2012 study were not available at this time, but Dr. Castro-Santos stated similar patterns were noted in the data between the years on the topic of upstream delay (personal communication, Dr. Theodore Castro-Santos). Similarly, concerns relative to the downstream passage of spent shad also remain relative to delays, with existing unpublished USGS telemetry data sets suggesting this is an issue within the Turners Falls canal.

Since the first year of operation of the Turners Falls upstream fishways (1980), the percent passage of American shad annually passed upstream of Turners Falls Dam compared to the number passed at the Holyoke Fish Lift has averaged 3.6% (1980-2012 data). The highest values for this metric has not exceed 11% and are well below the noted CRASC Management Plan target range for this objective noted earlier as 40-60% on a five year running average.

Since the first year of operation of the Vernon Dam upstream fish ladder (1981), the percent passage of American shad annually passed at Vernon compared to the number passed upstream of Turners Falls Dam (Gatehouse counts) has averaged 39.4%, ranging from 0.42% to 116.4% (> 100% due to counting error at one or both facilities, unknown).

Nexus to Project Operations and Effects

Existing project operations (peaking power generation) and limited bypass flows have a direct impact on instream flow and zones of passage (migration corridors). Project flow releases affect passage route selection, entry into fishways, and create delays to upstream migration. Inefficient downstream bypasses can result in migration delays and increased turbine passage. Mortality of adult shad passing through these turbines is expected to be high (Bell and Kynard 1985), additional stresses associated with passage and delay may cause mortality as shad are unable to return to salt water in a timely manner. The project's upstream and downstream passage facilities need to be designed and operated to provide timely and effective upstream and downstream fish passage to meet restoration goals of passage to upstream habitat and maximize post-spawn survival. These factors are all critically important to the success of restoration efforts.

Methodology

Use of radio including passive-integrated transponder (PIT) telemetry is widely accepted as the best method to assess fish migratory behavior and passage success and has been used extensively to assess migration and passage issues at Turners Falls as well as other Connecticut River projects. These studies include one conducted in 2011 and 2012 by the Service and U.S. Geological Survey's Conte Anadromous Fish Research Center, which has provided substantial information related to some of the issues identified here. The requested study will build and expand on the information collected over the past two years.

The study design must specify sample sizes, tag configurations and receiver configurations, to ensure that rates of entry and exit to the tailraces, fishways, downstream bypasses, and the bypassed reach can be calculated with sufficient precision to determine effectiveness of flow and ensonification treatments (separate Study Request). For project assessments at Turners Falls (e.g., Cabot, Spillway and Gatehouse ladder attraction and entry, route selection, operational effects), double tagged (radio and PIT) shad will be required for release from Holyoke Dam. Additional shad must be released directly into the Turners Falls Canal to support assessment of the various operational and structural conditions in effect, to be modified in this period, and proposed conditions within the Turners Falls power canal relative to entrances to the Gatehouse fishway. A related request on CFD modeling in the Cabot Station tailrace, the upper power canal near Gatehouse, and in the area around the entrance of the Spillway Ladder will address related project operational effects that will also address identified objectives in this telemetry request. Shad captured at Holyoke and tagged and release upstream of Turners Falls Dam, or tagged out of Gatehouse Ladder, would help to ensure an adequate sample size for evaluations in the vicinity of NMPS and to the Vernon Dam and the ability to address identified study objectives in those project areas. Additional tagged shad are expected to be required for release upstream of the Vernon Dam, which should ensure adequate sample for a separate study request, where shad spawn upstream of Vernon Dam as well as ensuring there is an adequate number of outmigrating spent adults to address related study objectives for adult outmigrants. The required number of tagged fish to address study objectives may be adjusted accordingly from area to area depending on target numbers (i.e., best information on resultant viable tagged fish and power analyses to detect effects) to account for typical passage rates, survival rates, and handling effects as examples.

Existing information on captured, handled, tagged fish performance (e.g., percent that drop back, unsuitable for tracking) and factors such as timing of tagging and potentially transport, must all be carefully considered to ensure an adequate sample size of healthy (e.g., viable to characterize behavior, survival, etc.) tagged fish is available to address the many questions identified in this request (as supported by a statistical power analysis). Additionally, ensuring adequate downstream adult fish sample sizes (to address project effect questions above) requires close consideration as expected losses of healthy tagged fish during upstream passage, natural mortality rates, and tagging related effects, are expected to reduce sample sizes on downstream passage objectives/questions as the season progresses. The use of single PIT tagged fish can help improve sample sizes, but will be of limited use to answer some of the passage questions we have identified.

Due to environmental variability, two years of study work will be necessary. A large array of stationary monitoring stations (radio and PIT) will be needed to address the issues identified among the project areas. A sufficient level of radio receiver and PIT reader coverage will be required, to provide an appropriate level of resolution, for data analyses, to answer these questions on project operational effects. The study will provide information on a variety of structural and operational aspects of fish migration, relative to route selection, timing, survival, and up and downstream passage attraction, retention, delay, efficiency, survival as some examples at three projects (Turners Falls, NMPS, and Vernon). The use of video monitoring may also be utilized for specific study areas such as the Spillway Ladder, to provide additional information on shad entrance activity, with the understanding of some data limitations associated with this approach (fish identification, water visibility). This study will be coordinated with the proposed study request to evaluate ensonification as a shad behavioral deterrent at the Cabot Station tailrace which will be an additional treatment of the telemetry study.

In addition to the tagging studies, use of video monitoring of the Spillway Fishway would provide additional overall data on Spillway Fishway efficiency as all shad attempting to pass could be monitored versus just those shad that have been tagged.

Level of Effort/Cost, and Why Alternative Studies will not suffice

The requested study is extensive and will require a substantial effort and cost to capture, PIT tag, and radio tag a sufficient number of shad at Holyoke to release at upstream locations. We are not aware of any other study technique that would provide project specific fish behavior and migration information to adequately assess existing project operations and provide insight in possible alternative operations and measures needed to address observed negative impacts to fish migration success. Video monitoring of the Spillway fishway would add a modest cost to this study.

Due to the fact tagged shad will move throughout the larger five project area, to varying degrees, there will be expected cost savings (e.g., radio tags) to both owner/operators, provided cooperation in study planning and implementation occurs.

Literature Cited

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Study Request 3: Evaluation of Timing of Downstream Migratory Movements of American Eels on the Mainstem Connecticut River (Docket Number p-1904) (Docket Number p-1855) (Docket Number p-1892)

Goals and Objectives

The goal of this study is to better understand migration timing of adult, silver-phase American eels as it relates to environmental factors and operations of mainstem hydropower projects on the Connecticut River.

The objectives of this study are:

1. Quantify and characterize the general migratory timing and presence of adult, silver-phase American eels in the Connecticut River relative to environmental factors and operations of mainstem river hydroelectric projects

Resource Management Goals

The Atlantic States Marine Fisheries Commission has developed two documents related to the management of American eel:

1. Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.
2. Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

Objectives of the management plan include: (1) protect and enhance American eel abundance in all watershed where eel now occur; and (2) where practical, restore American eel to those waters where they had historical abundance but may now be absent by providing access to inland waters for glass eel, elvers, and yellow eel and adequate escapement to the ocean for pre-spawning adult eel.

Addendum II contains specific recommendations for improving upstream and downstream passage of American eel, including requesting that member states and jurisdictions seek special consideration for American eel in the FERC relicensing process.

In addition, the Connecticut River Atlantic Salmon Commission (CRASC) developed A Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin in 2005. The goal of the plan is "to protect and enhance the abundance of the American eel resource to ensure its continued role in the Connecticut River Basin ecosystem…" Management objectives in the plan include the following:

1. Protect and enhance eel populations where they currently exist;
2. Where practical, restore populations to waters where they had historical abundance;
3. Provide effective upstream and downstream fish passage around dams and other barriers within the species' range in the basin; and
4. Comply with all requirements of the Fishery Management Plan of the ASMFC.

Based on these plans, the New Hampshire Fish and Game Department (NHFGD) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to downstream passage of American eel, the NHFGD's goals are:

1. Minimize current and potential negative project operation effects that could hinder management goals and objectives.
2. Minimize project-related sources of downstream passage delay, injury, stress, and mortality in order to maximize the number of silver eels migrating to the spawning grounds.

The American eel is also one of New Hampshire and Vermont's Species of Greatest Conservation Need (SGCN). The status for conservation need in Vermont is listed as high priority (Kart et al. 2005), and the species is listed as "vulnerable" in New Hampshire. As identified in Vermont's Wildlife Action Plan (Kart et al. 2005), threats to the species include the construction of large dams on rivers which obstruct juvenile fish access to critical rearing habitats, as well as mortality associated with passing through hydroelectric facilities' turbines during their outmigration to sea.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1) New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2) New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3) New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest
The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

Existing Information
Data on timing of downstream migratory movements and rates of American eels in the mainstem Connecticut River are sparse and relatively incomplete. Preliminary data on presence of "eel-sized" acoustic targets have been collected (Haro et al. 1998) within the Turners Falls Project's Cabot Station forebay that were somewhat confirmed by video monitoring at the Cabot Station downstream fish bypass; however, these were short-term studies, with acoustic monitoring only performed from 17 September to 5 October and video monitoring only conducted between 18 September to 22 October.

Some daily monitoring of the downstream bypass at the Holyoke Dam (canal louver array) was performed in 2004 and 2005 (Kleinschmidt, Inc. 2005, 2006, Normandeau Associates 2007); these studies also were of relatively short duration (spanning from October 5 to November 10 in 2004 and September 9 to November 11 in 2005) and the sampler was only operated at night.

To date, no other directed studies of eel migratory movements have been conducted at any location on the Connecticut River mainstem. This information gap needs to be filled, as it relates directly to when downstream passage and protection measures need to be operated.

We also note that within the past seven years, the United States Fish and Wildlife Service (USFWS) has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005 the USFWS issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability. On September 29, 2011 the USFWS issued a substantial 90-day finding and initiated a 12-month status review. It is our understanding that the USFWS is still accepting new American eel information for the ongoing status review.
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Nexus to Project Operations and Effects
The timing of downstream migration of adult eels is poorly defined for the Connecticut River; therefore the general effects of hydroelectric project operations on eel survival to the ocean are unknown. Although separate study requests have been submitted to address project-specific downstream passage route selection, delays, and mortality of eels, general characteristics of river flow and environmental conditions may have significant relationships with project operation and eel migratory success and survival. For example, eels may tend to move immediately before or during periods of significant precipitation (or consequently river flow); times at which projects may be generating at maximum capacity or spilling, which may (or may not) present a higher passage risk to eels. Conversely, periods of low flow may be associated with a significant proportion of total river flow passing through turbine units, which present additional (or different) passage risk to eels. If discrete conditions which promote eel downstream migration

are known, it may be possible to take actions with respect to project operations which reduce or minimize passage risk; i.e., operation of a bypass, reduction of intake approach velocities, directed spillage through a “safe” route, etc. These studies should provide baseline information on river-specific downstream migration to predict when silver-phase eels are expected to be migrating in the mainstem Connecticut River, from which project operations could be modified to minimize passage risks.

The studies are proposed for a single or multiple sites; the results will be relevant to all sites on the Connecticut River mainstem.

Methodology Consistent with Accepted Practice

Quantification of downstream movements of American eels in river systems requires systematic sampling of migrants throughout the migratory season. This can be accomplished with traditional active trapping methods; i.e., fyke or stow net sampling, weirs, or eel racks, but these methods are technically challenging on larger mainstem rivers, due to the scale of flows that need to be sampled, difficulties in operation throughout all flow conditions, and high debris loading during fall flows. Passive monitoring of migrant eels using hydroacoustic methods offers an alternative to active trapping. However, passive monitoring requires verification of potential acoustic targets with some level of active (collection) or visual (traditional optical or acoustic video) sampling.

Two potential locations offer opportunities to conduct simultaneous passive and active sampling: the Cabot Station (Turners Falls project) canal/forebay and the Holyoke Dam forebay and canal louver/bypass system. Each location possesses a route of downstream passage which conducts a significant proportion of river flow (Cabot canal and Holyoke forebay or canal), and each has a proximal bypass equipped with a sampler so that fish can be concentrated/collected from the passage route and identified to species. Project operations do influence the relative proportion of flow (and thus numbers of downstream migrant eels) in each passage route, so numbers of eels sampled in each route represent only a proportion of the total number of eels migrating downstream within the entire river. Because the absolute proportion of eels using a specific route at any one time is unknown, numbers of eels quantified within a route must serve as a relative index of the degree of migratory movement.

This study shall quantify eel movements in either one, or preferably both, locations for two consecutive years (since environmental conditions strongly influence migratory timing of eels, which can vary significantly from year to year; Haro 2003). Eels will be quantified using methods similar to Haro et al. (1999), by continuously monitoring a fixed location at the projects with hydroacoustics. Because eels tend to concentrate in areas of dominant flow (Brown et al. 2009, EPRI 2001), the zone to be monitored should pass a dominant proportion of project flow throughout most periods of operation (i.e., forebay intake area). Hydroacoustic monitoring shall encompass the entire potential migratory season, beginning in mid-August and ending in mid-December, and shall operate 24 hours per day. Data will be recorded for later processing and archiving.

Systematic active quantification of eels at downstream bypass samplers shall be performed simultaneously with passive hydroacoustic monitoring, to verify presence of eels and relative abundance of eel-sized hydroacoustic targets from the hydroacoustic data. Although daily operation of the bypass sampler could be performed, a more comprehensive technique is to monitor eels entering the bypass with an acoustic camera (i.e. DIDSON, BlueView, etc.). The acoustic camera will afford positive visual identification of eels as they enter the bypass, which is a concentration point for migrating eels. Acoustic camera monitoring will also allow monitoring to be performed 24 hours a day, and will be relatively unaffected by water turbidity (which influences effectiveness of traditional optical video monitoring). The acoustic camera system will be operated during the same time period as acoustic monitoring, and images will be recorded for later processing and archiving.

Data analyses of hydroacoustic, acoustic camera, bypass sampling, and environmental/ operational data will follow standard methodology.

Project operation (flows, levels, gate openings, number of units operating and operation level) and environmental conditions (river flow, temperature, turbidity, air temperature, precipitation) will be monitored regularly (hourly measurements if possible) throughout the duration of the studies.

These methodologies are consistent with accepted practice.

Level of Effort/Cost, and Why Alternative Studies will not suffice

The level of cost and effort for the downstream migrant eel migratory timing study would be moderate, given the level of cost for instrumentation, deployment, and data review/analysis.

The applicant did not propose any studies to meet this need in the PAD.

Literature Cited:

Brown, L.S. 2005. Characterizing the downstream passage behavior of silver phase American eels at a small hydroelectric facility. M.Sc. Thesis, Department of Natural Resource Conservation, University of Massachusetts, Amherst, Massachusetts. 110 pp.

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Kleinschmidt, Inc. 2006. Holyoke Project (FERC No. 2004) silver-phased American eel flow priority plan. Submitted to the City of Holyoke Holyoke Gas and Electric Department. 51 pp.

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Normandeau Associates, Inc. 2007. American eel emigration approach and downstream passage routes at the Holyoke Project, 2006. Submitted to the City of Holyoke Holyoke Gas and Electric Department. Final report. Normandeau Associates, Inc., Westmoreland, New Hampshire. 81 pp.

Study Request 4: Impact of Project Operations on Shad Spawning, Spawning Habitat, and Egg Deposition in the Project Areas of the Turners Falls, Northfield Mountain Pumped Storage and Vernon Project Areas and downstream from Bellow Falls Dam. (Docket Number p-1904)

Conduct a field study of spawning by American shad in the Connecticut River mainstem downstream of Turners Falls Dam, in the Turners Falls Dam impoundment, in the Vernon Dam Project area, and downstream of Bellows Falls Dam to determine if project operations (including operations of the Northfield Mountain Pump Storage) negatively impact shad spawning behavior, spawning habitat use, areal extent and quality of those spawning areas, and spawning activity in terms of egg deposition in those areas.

Goals and Objectives

Determine if project operations (under the permitted and proposed operational ranges) affect American shad spawning site use and availability, spawning habitat quantity and quality, and spawning activity in the river reaches downstream from Cabot Station and in the project bypass reach of Turners Falls Dam, in the Turners Falls Dam impoundment and in relation to Northfield Mountain Pump Storage operations, downstream and upstream of the Vernon Dam, and in the project area downstream of Bellows Falls Dam. The following objectives will address this request:

- Determine areas utilized by American shad for spawning by conducting night-time visual observation of spawning activity, identify and define areas geospatially, and obtain data on physical habitat conditions effected by project operations (e.g., water depth, velocity, discharge, substrate, exposure and inundation of habitats);
- Determine project operation effects on observed spawning activity, under a range of permitted or proposed project operation conditions;
- Quantify effects (e.g., water velocity, depths, inundation, exposure of habitats) of project operation on identified spawning areas for a range of conditions, over the complete period of spawning activity;
- Quantify spawning activity as measured by night-time spawning/splash surveys and egg collection in areas of spawning activity, and downstream of these areas, to further determine project operation effects (location extent of exposure from changing water levels and flows and on associated habitats from project operations).

If it is determined that the Project operations are adversely affecting the spawning activity of American shad and impacting spawning area habitat, identify operational regimes that will reduce and minimize impacts spawning habitat and spawning success, within the project area. This study will require two years of field data to capture inter-annual variability to river discharge and water temperatures and to allow for evaluation of alternative flow regimes if year one studies determine that the present peaking regime negatively affects spawning.

Resource Management Goals

The Connecticut River Atlantic Salmon Commission developed *A Management Plan for American Shad in the Connecticut River* in 1992. Management Objectives in the plan include the following:

1. Achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually.

2. Achieve annual passage of 40% to 60% of the spawning run (based on a 5-year running average) at each successive upstream barrier on the Connecticut River mainstem.

The Atlantic States Marine Fisheries Commission, Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management), approved in 2010 includes the following objective:

2. Maximize the number of juvenile recruits emigrating from freshwater stock complexesand recommendations:
3. To mitigate hydrological changes from dams, consider operational changes such as turbine venting, aerating reservoirs upstream of hydroelectric plants, aerating flows downstream, and adjusting in-stream flows.
4. Natural river discharge should be taken into account when instream flow alterations are being made to a river (flow regulation) because river flow plays an important role in the migration of diadromous fish.
5. Ensure that decisions on river flow allocation (e.g., irrigation, evaporative loss, out of basin water transport, hydroelectric operations) take into account instream flow needs for American shad migration, spawning, and nursery use, and minimize deviation from natural flow regimes.
6. When considering options for restoring alosine habitat, include study of impacts and possible alteration of dam-related operations to enhance river habitat.

The New Hampshire Fish and Game Department (NHFGD) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to American shad, the NHFGD's goals are:

1. Minimize current and potential negative project operation effects on American shad spawning and recruitment.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1) New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2) New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3) New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest
The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

Existing Information
Since the construction of the first fish lift facility at Holyoke Dam in 1967, American shad have had access to spawning and rearing habitat upstream from Holyoke Dam. A number of improvements to the Holyoke fishway have occurred since that time, but while the numbers of shad lifted at Holyoke have reached as much as 721,764 and the overall shad population to the river exceeded 1.6 million shad in 1992 (CRASC 1992), total shad population, and numbers of shad passing Turners Falls and Vernon Dam, have not met CRASC management plan objectives. Population number and passage numbers past Holyoke have declined substantially from those totals in recent years, with average Holyoke passage numbers over the last 10 years of 211,850. Since historically, approximately half of the returning population of shad to the river passed upstream of Holyoke, recent returns are far below management goals. Effective upstream and downstream passage and successful in-river spawning and juvenile production are necessary to help achieve shad management goals for the Connecticut River.

American shad broadcast spawn in congregations over shallow flats and rocky or sandy substrates (Davis et al, 1970, Mansuetti and Kolb 1953), at depths less than 10 feet and often far shallower with spawning fish swimming vigorously near the surface in a closely packed circle (Marcy 1972, Mackenzie et al 1985). Fertilized eggs drift downstream until hatching (Mackenzie et al 1985).

American shad are known to spawn downstream from the Turners Falls Project. Layzer (1974) identified 6 spawning sites from an area below the mouth of the Deerfield River (river mile 191.9) to river mile 161.7 below the Mill River in Hatfield, MA. Kuzmeskus (1977) verified 16 different spawning sites ranging from downstream of the Cabot tailrace to just upstream of the Holyoke dam (river mile 87.1). The only parameter that all spawning sites had in common was current (Kuzmeskus 1977). The NHFGD is not aware of any more recent studies that document whether these 16 sites are still viable spawning locations for shad. We are not aware of any studies that have determined American shad spawning habitat or spawning sites upstream of Vernon Dam to Bellows Fall Dam (historic extent of upstream range).

First Light Power conducted studies in the late spring and summer of 2012, examining habitat conditions downstream of the Turners Falls Dam. The study documented that in low flow conditions, Cabot Station project operations produced fluctuations in water level elevations that can range over 4 feet in magnitude (daily operation) at the USGS Montague Gage Station, to lower values of 2 to 3 feet at the Route 116 Bridge, Sunderland, MA (PAD). Similar short-term, limited monitoring in the upper Turners Falls Dam impoundment identified water level changes due to project operations that cyclically varied several feet on a sub-daily frequency.

Nexus to Project Operations and Effects

American shad are known to spawn at five locations downstream from the Turners Falls Project from an area below the mouth of the Deerfield River (river mile 191.9) and ten other locations downstream to river mile 161.7 below the Mill River in Hatfield (Layzer 1974, Kuzmeskus 1977).

Shad spawning is likely influenced by river flow, which fluctuates greatly due to the project's peaking mode of operation. These fluctuations may impact shad spawning activity by altering current velocities and water depth at the spawning sites. Effects on spawning behavior could include suspension of spawning activity, poor fertilization, flushing of eggs into unsuitable habitat due to higher peaking discharges, eggs dropping out into unsuitable substrate and being covered by sediment deposition, and/or eggs becoming stranded on dewatered shoal areas as peak flows subside.

While a number of shad spawning and egg deposition studies were conducted in the 1970s, that research was aimed at assessing the potential impact of developing a nuclear power station in the Montague Plains section of the Connecticut River. The NHFGD is not aware of any studies being conducted specifically designed to determine if a relationship exists between spawning behavior, habitat use, and egg deposition and project operations effects of the Turners Falls, Northfield Mountain Pump Storage and Vernon projects and downstream of Bellows Falls Dam..

The NHFGD is concerned that peaking operations may be altering spawning behavior and contributing to the failure of the Connecticut River shad population to meet CRASC management targets.

Methodology

The first year of study should examine known spawning areas downstream of the Turners Falls Dam project, to determine operation effects on shad spawning behavior, activity, and success. In areas upstream of Turners Falls Dam to the Bellow Falls Dam tailrace, the first year study should identify areas utilized for spawning by American shad. In the second year, should results from year one determine project operations affected spawning activity, access to habitat, or success, downstream of Turners Falls Dam, then an identical more detailed assessment (identified objectives) should be conducted in spawning areas upstream of Turners Falls Dam to the Bellows Falls Dam tailwater. Measures to reduce or eliminate any documented project operation impacts should be explored and evaluated in year two, downstream of Turners Falls Dam.

Potential impacts to spawning behavior would best be studied by night-time observations of actual in-river spawning behavior (Ross et al. 1993). Project discharge increases or decreases during actual observed spawning activity will provide empirical evidence of change in behaviors. The observational methodology should follow the protocol specified in Layzer (1974) and/or as described in Ross et al. (1993). The analysis should utilize the observational field data in conjunction with operational data from the projects (station generation and spill on a sub-hourly basis). To assess the impacts of changes in generation flows, the study should include scheduled changes in project operation to ensure that routine generation changes that occur during the nighttime spawning period affect downstream spawning habitats selected for study while shad are spawning. Stier and Crance (1985) provide optimal water velocities during spawning to range between 1 to 3 ft/sec.

In areas used for spawning, the characteristics of those areas (e.g., location, depth, flow, substrate) should be recorded. The effect of project operations (discharge, water velocity, inundation and exposure) should be assessed. Drift nets will be used to collect eggs to quantify egg production before and after flow changes at the spawning site.

In the reaches above the Turners Falls dam, night time observations of splashing associated with shad spawning should be performed in each reach as sufficient numbers of shad are passed above each dam. Observations should be performed regularly until the end of the spawning season. The use of radio-tagged adult shad from a separate Study Request will aid in this effort. An estimate of the total area used for spawning and an index of spawning activity should be recorded for each site.

Level of Effort/Cost, and Why Alternative Studies will not suffice

Neither First Light or TransCanada propose any studies to meet this need. Estimated cost for the study is expected to be moderate for each owner, with the majority of costs associated with fieldwork labor.

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Stier, D. J. and J. H. Crance. 1985. Habitat suitability index models and instream flow suitability curves: American shad. U. S. Fish and Wildlife Service Biological Report No. 82(10.88), Washington, D.C.

Study Request 5: Bellows Falls Bypass Flow (Docket Number p-1855)

Goals and Objectives

The goal of this study is to determine an appropriate bypass flows that will protect and enhance the aquatic resources of the Bellows Falls bypass reach.

The objective of the study will be to evaluate the relationship between flow and habitat suitability in the bypass reach.

Relevant Resource Management Goals

The New Hampshire Fish and Game Department (NHFGD) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to aquatic resources within the Bellows Falls bypass reach, the NHFGD's goals are:

1. Protect, enhance, or restore, diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Provide appropriate flows in the bypass reach that meets the life history requirements of resident fish and wildlife, including freshwater mussels and other benthic invertebrates.
3. Minimize current and potential negative project operation effects on water quality and aquatic habitat.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1) New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2) New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3) New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Background and Existing Information

The Bellows Falls Project bypasses a 3,500 foot-long section of the Connecticut River. Presently this bypass reach only receives flow when inflow exceeds the hydraulic capacity of the Bellow Falls station. According to exceedance curves provided in the PAD, on a monthly basis the bypass reach receives flow the following amount of time:

Month	**% time flow > 11,000 cfs**	**Month**	**% Time Flow >11,000 cfs**
Jan.	15	July	10
Feb.	15	August	8
March	50	Sept.	4
April	90	Oct.	20
May	60	Nov.	35
June	20	Dec.	26

No information exists on the adequacy of the existing bypass flow regime to protect water quality and aquatic life. The bypass reach receives flow less than 30% of the time on an annual basis. The PAD provides no detailed description of the physical or biological characteristics of the bypass reach.

An empirical study is needed to provide information on the relationship between flow and habitat in the bypass reach for the NHFGD to use in determining appropriate flows in the bypass reach.

Project Nexus

The Project includes a 3,500-foot-long bypass reach. Absent a mandated discharge at the dam, this habitat would reamin dewatered during those times when inflow was within the hydraulic capacity of the units (~70% of the time on an annual basis). The existing license does not require any flow through the bypass reach. The current situation does not sufficiently protect the aquatic resources inhabiting or potentially inhabiting the bypass reach.

The Connecticut River in the project vicinity is dominated by sections that are impounded, backwatered from downstream impoundments or otherwise deep and slow-flowing. In contrast, the Bellows Falls bypass channel is very irregular and diverse, consisting of both coarse substrate of various sizes and in the more downstream segment, jagged, irregular ledge. Given an adequate flow regime, the bypass could provide habitat types that are now rare and therefore of great importance.

Results of the flow study will be used by the NHFGD to determine an appropriate flow recommendation that will protect and/or enhance the aquatic resources in the bypass reach for the duration of any new license issued by the Commission.

Proposed methodology

The NHFGD requests a bypass flow study be conducted at the Project. Bypass flow habitat assessments are commonly employed in developing flow release protocols that will reduce impacts or enhance habitat conditions in reaches of river bypassed by hydroelectric projects. Given the size of the bypass reach (3,500 feet long) and the rareness of the habitat types it contains in this portion of the Connecticut River, we believe a study methodology that utilizes an IFIM approach is appropriate for this site. This same protocol was used during the relicensing of the Housatonic River Project (FERC No. 2576),[1]and has been accepted by the Commission in other licensing proceedings[2].

Given the unique channel formation habitat modeling using standard PHABSIM 1 dimensional modeling may not be sufficient to assess the habitat suitability in the bypass reach but rather 2 dimensional, 2D modeling may be needed to better characterize flows and velocities in this reach. We recommend that the approach to habitat modeling be determined during the study plan development stage based on consultations between the applicant and the resource agencies.

Level of effort and cost

The expected level of effort and anticipated costs will be comparable to that experienced on similar FERC relicensing projects of this size.

Field work for flow studies can be reasonably extensive but will depend on consultation with the applicant on study methodology and on-site decisions on locations for data collection and the number of collection locations. Post-fieldwork data analysis would be a moderate cost and effort. Field work associated with this study could be done in conjunction with the Instream Flow Study Request. We anticipate that the level of effort and costs will be comparable to that experienced on similar FERC relicensing projects (e.g., the Glendale Project, FERC No. 2801).

Literature Cited:

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

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[1] Housatonic River Project License Application, Volume 4, Appendix F. Connecticut Light and Power Company, August 1999.

[2] Glendale Project (FERC No. 2801) Final Bypass Reach Aquatic Habitat and Instream Flow Study in Glendale Hydroelectric Project Application for Subsequent License (FERC No. 2801), Volume 2, Appendix B, pages 7-8, October 2007.

Study Request 6: Shad Population Model for the Connecticut River (Docket Number p-1904) (Docket Number p-1855) (Docket Number p-1892)

Develop an American shad annual step, mathematical simulation population model for the Connecticut River to quantify how project operations and potential restoration/mitigation measures impact the population of shad in the Connecticut River.

Goals and Objectives

The goal of the model is to assess impacts of both upstream and downstream passage at each of the Connecticut River projects and potential management options for increasing returns to the river.

Specific objectives include:

- Annual projections of returns to the Connecticut River;
- A deterministic and stochastic option for model runs
- Life history inputs of Connecticut River shad
- Understanding the effect of upstream and downstream passage delay at projects
- Calibration of the model with existing data
- Analysis of the sensitivity of model inputs
- Analysis of sensitivity to different levels of up- and downstream passage efficiencies at all projects
- Multiple output formats including a spreadsheet with yearly outputs for each input and output parameter

Resource Management Goals

The Connecticut River Atlantic Salmon Commission (CRASC) developed *A Management Plan for American Shad in the Connecticut River* in 1992. Management Objectives in the plan include the following:

1 Achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually.

2 Achieve annual passage of 40 to 60% of the spawning run (based on a 5-year running average) at each successive upstream barrier on the Connecticut River mainstem.

3 Maximize outmigrant survival for juvenile and spent adult shad.

The New Hampshire Fish and Game Department (NHFGD) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1 Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.

2 Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to American shad, the NHFGD's goals are:

1 Minimize current and potential negative project operation effects on American shad spawning and recruitment.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1) New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2) New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3) New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

Existing Information

Since the construction of the first fish lift facility at Holyoke Dam in 1967, American shad have had access to spawning and rearing habitat upstream from Holyoke Dam. A number of improvements to the Holyoke fishway have occurred since that time, but while the numbers of shad lifted at Holyoke have reached as much as 721,764 and the overall shad population to the river exceeded 1.6 million shad in 1992 (CRASC 1992), total shad populations, and numbers of shad passing Holyoke, Turners Falls and Vernon Dam have not met CRASC management goals.

Population and passage numbers past Holyoke have declined substantially from those totals in recent years, with average Holyoke passage numbers since 2000 of 229,876. Whole river population estimates have shown that approximately half of the returning population of shad pass upstream of Holyoke. Recent returns to Holyoke are far below management goals.

Average passage efficiency of shad at Turners Falls (Gatehouse counts) and Vernon since 2000 has been 3.1 and 20.4 % respectively. These too are well below the CRASC management goals.

Safe, timely and effective up- and downstream passage along with successful spawning and juvenile production are necessary to help achieve shad management goals for the Connecticut River.

Nexus to Project Operations and Effects

Existing project operations and fish ladder efficiencies have a direct effect on shad populations in the Connecticut River. Poor upstream passage efficiencies and delays restrict river access to returning shad. Fish unable to reach upriver spawning grounds may not spawn or have reduced fitness or survival of young. Poor downstream passage survival and downstream passage delays affect outmigration and consequently repeat spawning, an important ecological aspect of the iteroparous Connecticut River shad population (Limberg et al. 2003).

The NHFGD is concerned that poor passage efficiencies and delays at projects may be limiting access to upstream reaches of the river, altering spawning behavior, decreasing outmigration survival and contributing to the failure of the Connecticut River shad population to meet management targets (Castro-Santos and Letcher 2010).

Development of a population model will allow an assessment of individual project impacts on the population as well as the cumulative impacts of multiple projects. The model will allow managers to direct their efforts in the most efficient manner toward remedying the conditions that most impact the shad population.

Methodology

Population models are commonly used to assess anthropomorphic and natural impacts and are consistent with accepted practice. A model similar to this request was constructed for the Susquehanna River by Exelon (FERC #405, RSP 3.4). The model is constructed in Microsoft Access

Specific parameters that would be included in the model:

- Upstream passage efficiency at Holyoke, Turners Falls (Cabot, Gatehouse and Spillway Ladders), Vernon fishways, and any impacts associated with Northfield Mountain.
- Distribution of shad approaching the Turners Falls project between the Cabot Ladder and the spillway at the dam
- Downstream passage efficiencies at Vernon, Northfield Mountain, Turners Falls, and Holyoke projects for juveniles and adults
- Entrainment at Mount Tom and Vermont Yankee
- Sex ratio of returning adults
- The proportion of virgin female adults returning at 4, 5, 6, and 7 years
- The proportion of repeat spawning females at 5, 6 and 7 years
- Spawning success of females in each reach
- Fecundity
- Percent egg deposition
- Fertilization success

- Larval and juvenile in-river survival
- Calibration factor to account for unknown parameters such as at sea survival
- Options for fry stocking and trucking as enhancement measures
- Start year and model run years
- Start population
- Rates of movement to and between barriers
- Temperature, river discharge, and other variable of influence to migration and other life history events

The model should be adaptable to allow the input of new data and other inputs.

Level of Effort/Cost, and Why Alternative Studies will not suffice

Neither First Light nor TransCanada have proposed any study to meet this need. Estimated cost for the study is expected to be low to moderate. As the model describes the impacts of multiple projects and two owners, both project owners would share the cost of model development.

Literature cited:

CRASC (Connecticut River Atlantic Salmon Commission). 1992. A management plan for American shad in the Connecticut River basin. Sunderland, MA

Castro-Santos, T and B. H. Letcher. 2010. Modeling migratory bioenergetics of Connecticut River American shad (*Alosa sapidissima*): implications for the conservation of an iteroparous anadromous fish. Can.J.Fish.Aquat.Sci. 67: 806-830

Limberg, K. E., K. A. Hattala, and A. Kahne. 2003. American shad in its native range. Pages 125-140 in K. E. Limberg and J. R. Waldman, editors. Biodiveristy, status and conservation of the world's shads. American Fisheries Society, Symposium 35, Bethesda, Maryland

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 7: American Eel Survey Upstream of the Vernon, Bellows Falls, and Wilder Dams (Docket Number p-1904) (Docket Number p-1855) (Docket Number p-1892)

Goals and Objectives

The goal of this study is to provide baseline data relative to the presence of American eel upstream of the Vernon, Bellows Falls, and Wilder Dams.

The objective of the study is to determine the relative abundance and distribution of American eel upstream of the Vernon, Bellows Falls and Wilder Dams in both riverine and lacustrine habitat.

Relevant Resource Management Goals

The Atlantic States Marine Fisheries Commission has developed two documents related to the management of American eel:

1 Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.
2 Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

Objectives of the management plan include: (1) protect and enhance American eel abundance in all watersheds where eel now occur; and (2) where practical, restore American eel to those waters where they had historical abundance but may now be absent by providing access to inland waters for glass eel, elvers, and yellow eel and adequate escapement to the ocean for pre-spawning adult eel.

Addendum II contains specific recommendations for improving upstream and downstream passage of American eel, including requesting that member states and jurisdictions seek special consideration for American eel in the FERC relicensing process.

In addition, the Connecticut River Atlantic Salmon Commission (CRASC) developed A Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin in 2005. The goal of the plan is "to protect and enhance the abundance of the American eel resource to ensure its continued role in the Connecticut River Basin ecosystem…" Management objectives in the plan include the following:

1 Protect and enhance eel populations where they currently exist;
2 Where practical, restore populations to waters where they had historical abundance;

3 Provide effective upstream and downstream fish passage around dams and other barriers within the species' range in the basin; and
4 Comply with all requirements of the Fishery Management Plan of the ASMFC.

Based on these plans, the New Hampshire Fish and Game Department (NHFGD) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to American eels, the NHFGD's goals are:

1. Protect, enhance, or restore, diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Understand the baseline condition with respect to the presence of American eel within and upstream of the project area.
3. Minimize current and potential negative project operation effects on American eel inhabiting the project area and/or moving through the area during upstream and downstream migrations

The American eel (*Anguilla rostrata*), is also listed as one of both New Hampshire's and Vermont's Species of Greatest Conservation Need (SGCN). The status for conservation need in Vermont is listed as high priority (Kart et al. 2005), and the species is listed as "vulnerable" in New Hampshire. As identified in Vermont's Wildlife Action Plan (Kart et al. 2005), threats to the species include the construction of large dams on rivers which obstruct juvenile fish access to critical rearing habitats, as well as mortality associated with passing through hydroelectric facilities' turbines during their outmigration to sea.

As outlined in Vermont's Wildlife Action Plan (Kart et al. 2005), research and monitoring needs for this SGCN include determining their distribution and abundance, as the contribution of eels in northern regions to overall stock is unknown. One of the conservation strategies for this species is to support efforts to enhance access of American eels to Vermont waters by minimizing impacts of dams and other obstructions along the Richelieu, St. Lawrence, and Connecticut Rivers.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1) New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2) New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3) New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

Background and Existing Information

According to the PADs, very few American eels were collected in the Fish Assemblage and Habitat Assessment of the Upper Connecticut River (Yoder et al., 2009). In the Vernon Project area upstream of the dam, only one eel was collected; no eels were collected from the Bellows Falls pool, and none were found upstream of the Wilder Dam. However, in 2012 over 200 eels were documented using the upstream fish ladder at the Vernon Project and the New Hampshire Fish and Game Department has observed eels upstream of the Bellows Falls and Wilder dams. More recently, eels have been observed in Lake Morey, Vermont, which is located upstream of Wilder Dam (Lael Will, VDFW, personal communication). Therefore, while it is clear that some eels are passing all three dams (Vernon, Bellows Falls, and Wilder), it remains unknown how many eels may be rearing in the mainstem habitat upstream of the dams or in tributaries and lakes and ponds that feed into the mainstem river.

No targeted eel surveys have been conducted to determine the abundance and distribution of American eels in riverine and lacustrine habitat upstream of the three projects. This information gap needs to be filled so resource agencies can evaluate properly the need for, and timing of, downstream passage and protection measures for outmigrating silver phase eels.

We also note that within the past seven years, the United States Fish and Wildlife Service (USFWS) has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005 the USFWS issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability. On September 29, 2011 the USFWS issued a substantial 90-day finding and initiated a 12-month status review. It is our understanding that the USFWS is still accepting new American eel information for the ongoing status review.

Project Nexus

The project configurations present problems with respect to providing safe, timely and effective passage for outmigrating eels. The intakes are deep and, while no specification for the trashracks were provided in the PADs, it is unlikely that they would prevent impingement and/or entrainment of eels. Existing anadromous downstream passage facilities at the projects also would not be expected to be effective for eels; the target anadromous species are surface-oriented, while eels tend to move much deeper in the water column. If eels are utilizing habitat upstream of the dams, then appropriate protection and downstream passage measures will be needed.

In order to understand the need for, and timing of, downstream eel passage at the projects, we are requesting that TransCanada undertake eel surveys in the Connecticut River upstream of the three dams and in tributaries feeding into the mainstem river within the project areas. Surveying tributary habitat is necessary because surveying the mainstem alone may lead to an underestimation of eel abundance, particularly if there are relatively short tributary streams that lead to a lake or pond (where eels may accumulate, leading to true high densities).

Proposed methodology

The NHFGD requests an eel survey be conducted in the mainstem river and tributaries upstream from the three projects. The methodology should be similar to that used in the relicensing of the Saluda Hydroelectric Project, FERC No. 516 (Appendix A), the eel assessment for the Merrimack River completed by the Service's Central New England Fishery Resources Office (Appendix B), and the proposed study plan for the relicensing of the Eastman Falls Project (FERC No. 2457)[3].

In general, a combination of electroshocking (backpack in wadeable rivers and boat-mounted in larger rivers and lakes) and eel pots should be used to collect eels and determine catch rates. Sampled habitat should include: the mainstem Connecticut River from upstream of Vernon Dam to below the Ryegate Dam; tributaries to the Connecticut within that stretch where eels have been collected previously; and lakes and ponds (such as, but not limited to, Spofford Lake and Lake Morey), where eels have been collected previously. Sampling should occur during the summer (July through September).

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[3] FERC Accession No. 20121214-5121

Level of effort and cost

The expected level of effort and anticipated costs will be comparable to that experienced on similar FERC projects of this size. A study plan recently submitted for the Eastman Falls Project (FERC No. 2457) on the Pemigewasset River in New Hampshire, which is utilizing a similar methodology, estimated that sampling a nine-mile-long impoundment with shocking and eel pots would cost $25,000. They estimated the effort to be two nights for the electrofishing survey. Given the much larger area that will need to be sampled under this request, we estimate moderate cost and effort will be required (20 days of shocking mainstem habitat plus another 5-10 days for tributaries and associated lake/pond habitat).

Literature Cited

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department. Waterbury, Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm. (Accessed September 10, 2012).

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 8: Channel Morphology and Benthic Habitat Impacts at the Vernon, Bellows Falls and Wilder Projects (Docket Number p-1904) (Docket Number p-1855) (Docket Number p-1892)

It is well known that dams interrupt the downstream continuum of sediment supply and transport, which in turn can affect channel morphology and limit the amount of coarse (i.e. gravel/cobble) substrate available for aquatic biota. The Vernon, Bellows Falls and Wilder projects' effects on fluvial processes, channel formation and associated anadromous and riverine fish habitat, as well as aquatic invertebrate habitat, is unclear. This study request aims to provide information on coarse sediment supply and transport as it relates to aquatic benthic habitat (e.g. gravel bars). Results will be used to identify techniques to minimize and/or mitigate impacts to this valuable habitat.

Goals and Objectives

The goal of this study is to understand how the projects affect bedload distribution, particle size and composition as it relates to habitat availability (amount and size of coarse substrate material) for different life-history stages of anadromous (e.g. sea lamprey) and riverine fishes (e.g. walleye), as well as invertebrates (e.g., tiger beetles, mussels- such as the federally-endangered dwarf wedgemussel).

The study objectives include:

1. Assess the distribution and extent of the existing substrate types, including gravel and cobble bars within the project affected areas.

2. Identify the current conditions of the channel and determine the stability of the present substrate/benthic habitat and identify if flow or sediment measures are necessary to improve the aquatic benthic habitat.

Resource Management Goals

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the Vermont Fish and Wildlife Department's (VTFWD) mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005). Two of the VTFWD's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.

2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1. New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2. New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3. New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4. Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Gravel/cobble habitat is utilized by various riverine fish species during different life history stages and seasons, as it provides sites for spawning, feeding, and refuge (Gore and Shields 1995). Many fish species and aquatic invertebrates (e.g., fresh water mussels, snails, worms, and aquatic insects) live on or near gravel habitat, because it provides a source of food and cover (Miller 1988). Gravel bars also play an important role in water quality, hydrology, and morphology of rivers (Lewis 2005).

As identified in Vermont's Wildlife Action plan (Kart et al. 2005), several state listed mussel species are known to utilize gravel-type substrate. Furthermore, sea lamprey (*Petromyzon marinus*) spawning occurs over substrate composed of a mixture of sand, gravel and rubble. The sea lamprey, within the Connecticut River drainage, is one of New Hampshire and Vermont's Species of Greatest Conservation Need (SGCN). The conservation status of sea lamprey in New Hampshire is listed as "vulnerable." One of the threats identified in Vermont's Wildlife Action Plan (Kart et al. 2005) is degraded spawning habitat, which is second to habitat fragmentation. In support of the VTFWD and the NHFGD's missions, and the Vermont Water Quality Standards, it is important to gain a better understanding of the benthic habitat present in project affected areas and how projects operations may be affecting this habitat.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

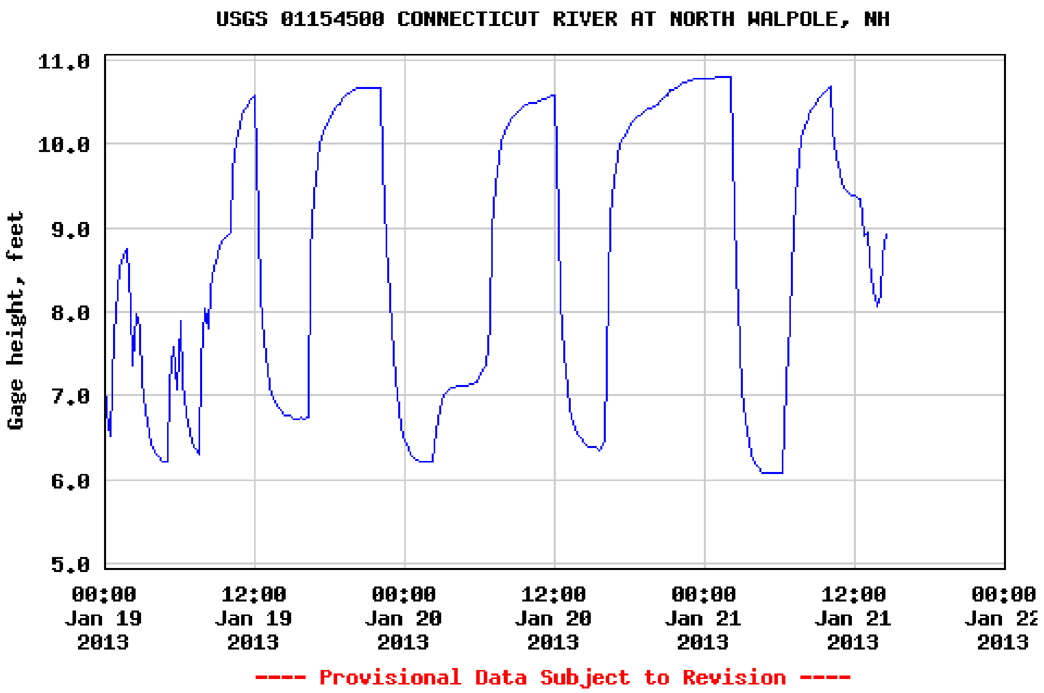
The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

Existing Information
The PAD generally focuses on erosional impacts due to the projects' operations, but lacks specific information on fluvial geomorphic processes and substrate composition as it relates to impacts to aquatic benthic habitat. Recent studies assessing fluvial geomorphic process and substrate composition in Connecticut River tributaries have documented the impacts of regulated flows from dams on substrate composition, and the possible impacts on the mainstem of the river.

Curtis et al. (2010) utilized a combination of historical aerial photographs, mainstem- and tributary-channel pebble counts, and HEC-RAS flow modeling in the West and White River watersheds (tributaries to the Connecticut River). They documented the time series of post-regulation channel narrowing and associated bar growth due to the influx of tributary sediment. In the West River, Svendsen et al. (2009) quantified changes in channel bed morphology as a result of flow regulation. Utilizing bi-monthly cross-section data from the gauging stations they determined the mean water depth and bed elevation for each cross-section measurement during the pre-dam and post-dam periods. In addition, annual peak stream flow data for each station were used to calculate the flood recurrence, and surface grain distributions at sampling sites upstream and downstream of each tributary confluence using Wolman pebble counts. They found that the sediment load from tributaries are impacting the flow-regulated mainstem West River rather than ameliorating conditions, and that these impacts are reflected in the benthic community structure. These results indicate that environmental flows that mimic the natural hydrograph are needed in regulated reaches of river.

Nexus to Project Operations and Effects
Dams have major impacts on geomorphic processes, ecological function and in turn biotic communities. Changes to substrate composition can significantly affect aquatic life including stability of channel habitats, size distribution and embeddedness of substrate, and decreased habitat diversity and heterogeneity. The projects impound a large portion of the Connecticut River that otherwise would be free flowing and would transport fine sediment downstream leaving larger substrate material (gravel/cobble) exposed to be utilized by aquatic biota. By interrupting the downstream continuum of sediment supply and transport, dams can result in increased bed scour and bank erosion downstream (Kondolf and Matthews 1993). Given the large number of mainstem dams on the Connecticut River, any gravel coming in from tributaries becomes very important to the system. However, many of the tributaries in the project reach have also been dammed. Therefore, there is reason to be concerned about the effects the project dams are having on river processes and physical habitat.
Currently, the projects operate as hydro-peaking facilities as is evident from the USGS stream flow gauge at North Walpole, NH; with large water releases below the dam that increase shear stress on the river bed, substrate is mobilized that otherwise would only be moved during seasonal high flow events. Operations of the existing TransCanada hydroelectric projects likely affect channel morphology and fluvial processes including substrate mobility and particle size distribution. Project-induced changes to natural fluvial processes and channel morphology and substrate composition can have negative impacts on aquatic resources. For example, changes in

sediment composition could relocate or decrease important walleye or sea lamprey spawning habitat. In a similar fashion, project-induced changes could make some habitats unsuitable for aquatic invertebrates, including the federally-endangered dwarf wedgemussel. The NHFGD requests a study investigating the impacts of project operations on fluvial processes, substrate composition and stability as it relates to aquatic benthic habitat. Results of this study will be used to develop potential license requirements to protect aquatic habitat in the project-affected areas, and may be used to inform other studies that evaluate project effects on related resources. Possible mitigation measures could include gravel augmentation, changes in flow regulation, and instream channel restoration.
An example of the water level fluctuations that occur in the Connecticut River due to hydropower generation is shown below.



Methodology Consistent with Accepted Practice
Geomorphology studies are generally conducted during hydroelectric relicensing projects to determine channel condition, and substrate composition, and determine whether changes in project operations or sediment measures are necessary and/or whether channel restoration is necessary to improve aquatic benthic habitat.

The NHFGD recommends a methodology similar to previously approved FERC studies (FERC No. 2246 and 2206). Specific study methods include, but are not limited to, utilizing a combination of historical aerial photographs, pebble counts, and HEC-RAS flow modeling to document and compare temporal changes in morphology and sediment transport dynamics in the project affected areas.

Additional study methods can be found in the FERC Project No. 2246, Yuba County Water Agencies Study Plan Determination: Study 1.1. Lemonds (2006) also conducted an empirical-based study for the Yadkin-Pee Dee River Hydroelectric Project No. 2206.

Level of Effort/Cost, and Why Alternative Studies will not suffice
At a minimum, the study would require a combination of historical aerial photographs, pebble counts, and HEC-RAS flow modeling. Cross-section data from the gauging stations could be used to determine the mean water depth and bed elevation for each cross-section measurement. TransCanada has not proposed any studies to meet this need. Costs would be low to moderate.

Literature Cited:

Curtis, K.E., C.E. Renshaw, F. J. Magilligan, and W.B. Dade. 2010. Temporal and spatial scales of geomorphic adjustments to reduced competency following flow regulation in bedload-dominated systems. Geomorphology. 118: 105–117

Gore, J. A., and F. D. Shields. 1995. Can large rivers be restored? Bioscience 45:142-152.

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department. Waterbury, Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm. (Accesse September 10, 2012).

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Lemonds, R.W. 2006. Delineating River Bottom Substrate using Very High-Resolution Digital Imagery derived from Large Scale Aerial Photography. North Carolina State University Master’s Thesis.

Lewis. L. 2005. Arkansas River navigation project mitigation proposal and the Arkansas River conservation initiative. United States Fish and Wildlife Service Concept Paper.

Miller, A. C. 1988. Experimental gravel bar habitat creation in the Tombigbee River Mississippi. U.S. Army Engineer Research and Development Center. Technical Note 07-4.

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Svendsen, K.M., C. E. Renshaw, F. J. Magilligan, K. H. Nislow and J. M. Kaste. 2009. Flow and sediment regimes at tributary junctions on a regulated river: impact on sediment residence time and benthic macroinvertebrate communities. Hydrological Processes. 23: 284–296.

Study Request 9: Downstream American Eel Passage Assessment at Vernon, Bellows Falls, and Wilder. (Docket Number p-1904) (Docket Number p-1855) (Docket Number p-1892)

Goals and Objectives

The goal of this study is to determine the impact of three hydroelectric projects on the outmigration of silver eels in the Connecticut River. Entrainment at the conventional turbines at the Vernon, Bellows Falls, and Wilder projects can result in mortality or injury. It is important to understand the passage routes at each project and the potential for delay, injury, and mortality to assess alternative management options to increase survival.

The objectives of this study are:

1. Quantify the movement rates (including delays) and relative proportion of eels passing via various routes at the projects (i.e. through the turbines, through the downstream bypasses; spilled at the dams, etc.).
2. Evaluate instantaneous and latent mortality and injury of eels passed via each potential route.

Resource Management Goals

The Atlantic States Marine Fisheries Commission has developed two documents related to the management of American eel:

5 Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.
6 Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

Objectives of the management plan include: (1) protect and enhance American eel abundance in all watershed where eel now occur; and (2) where practical, restore American eel to those waters where they had historical abundance but may now be absent by providing access to inland waters for glass eel, elvers, and yellow eel and adequate escapement to the ocean for pre-spawning adult eel.

Addendum II contains specific recommendations for improving upstream and downstream passage of American eel, including requesting that member states and jurisdictions seek special consideration for American eel in the FERC relicensing process.

In addition, the Connecticut River Atlantic Salmon Commission (CRASC) developed A Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin in 2005. The goal of the plan is “to protect and enhance the abundance of the American eel resource to ensure its continued role in the Connecticut River Basin ecosystem…” Management objectives in the plan include the following:

1 Protect and enhance eel populations where they currently exist;
2 Where practical, restore populations to waters where they had historical abundance;

3 Provide effective upstream and downstream fish passage around dams and other barriers within the species' range in the basin; and
4 Comply with all requirements of the Fishery Management Plan of the ASMFC.

Based on these plans, the New Hampshire Fish and Game Department (NHFGD) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1 Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2 Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to downstream passage of American eel, the NHFGD's goals are:
1 Minimize current and potential negative project operation effects that could hinder management goals and objectives.
2 Minimize project-related sources of downstream passage delay, injury, stress, and mortality in order to maximize the number of silver eels migrating to the spawning grounds.

The American eel (*Anguilla rostrata*), is also one of New Hampshire and Vermont's Species of Greatest Conservation Need (SGCN). The status for conservation need in Vermont is listed as high priority (Kart et al. 2005), and the species is listed as "vulnerable" in New Hampshire. As identified in Vermont's Wildlife Action Plan (Kart et al. 2005), threats to the species include the construction of large dams on rivers which obstruct juvenile fish access to critical rearing habitats, as well as mortality associated with passing through hydroelectric facilities' turbines during their outmigration to sea.

As outlined in Vermont's Wildlife Action Plan (Kart et al. 2005), research and monitoring needs for this SGCN include determining their distribution and abundance, as the contribution of eels in northern regions to overall stock is unknown. One of the conservation strategies for this species is to support efforts to enhance access of American eels to Vermont waters by eliminating or minimizing impacts of dams and other obstructions along the Richelieu, St. Lawrence, and Connecticut Rivers.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.

2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

Existing Information

The PAD contains information on the biology and life history of the American eel. It also summarizes eel collection data within the Vernon and Bellows Falls project areas. Eels have been collected both upstream and downstream of the Vernon Project and also have been counted passing the upstream anadromous fish ladder. Eels also have been documented upstream of the Bellows Falls and Wilder projects.

To date, no directed studies of eel entrainment or mortality have been conducted at any of the projects. These information gaps need to be filled so resource agencies can assess the relative and cumulative impact of project operations on outmigrating eels and develop adequate passage and protection measures to meet management goals and objectives.

We also note that within the past seven years, the United States Fish and Wildlife Service (USFWS) has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005 the USFWS issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability. On September 29, 2011 the USFWS issued a substantial 90-day finding and initiated a 12-month status review. It is our understanding that the USFWS is still accepting new American eel information for the ongoing status review.

Nexus to Project Operations and Effects

The Vernon, Bellows Falls, and Wilder projects operate as peaking facilities, except during periods when inflow exceeds the hydraulic capacities of the stations. Silver eels outmigrate during the mid- summer through late fall, a time of year when flows are generally within the operating capacities of the stations. Therefore, the projects would be expected to spill infrequently during the silver eel outmigration.

The project configurations present problems with respect to providing safe, timely and effective passage for outmigrating eels. The intakes likely are deep and, while no specification for the trashracks were provided in the PADs, it is unlikely that they would prevent impingement and/or entrainment of eels. Existing anadromous downstream passage facilities at the projects also would not be expected to be effective for eels; the target anadromous species are surface-oriented, while eels tend to move much deeper in the water column. Eels are known to occur upstream of the dams; therefore, it is necessary to understand how eels move through the projects and the level of injury or mortality caused by entrainment through the projects' turbines.

Methodology Consistent with Accepted Practice

In order to understand the movements of outmigrating silver eels as they relate to operations at the Vernon, Bellows Falls, and Wilder projects, radio telemetry technology should be utilized. Radio telemetry is an accepted technology that has been used for a number of studies associated with hydropower projects, including at the Muddy Run Project (FERC No. 2355).

Studies should be designed to investigate route selection (i.e., entrainment vs. spill) independently from estimation of mortality/injury, because these metrics require different telemetric methodologies. Studies also will likely benefit from data collected over both study years (especially route selection studies, which may be more significantly affected by environmental conditions during a given season that mortality/injury studies). It is also envisioned that results from route selection studies can guide design of turbine mortality studies. Therefore, it is proposed, at a minimum, that route selection studies be conducted in multiple years, but mortality/injury studies may be conducted after the first year of route selection studies has been completed.

1. **Objective 1: Route Selection**

   This study will involve systematic releases of radio-tagged silver phase eels at strategic points above areas of interest, to assess general routes of passage (i.e., via spill, bypass, or turbines). Active downstream migrants should be collected within-basin if possible (i. e., Cabot or Holyoke bypass samplers), but fish sourced from out of basin may be acceptable to meet sample size demands. Experimental fish must meet morphometric (e.g. eye diameter relative to body size) criteria to ensure they are migrant silver phase. Collections should be made within the migratory season (late Aug to mid Oct), and eels should be tagged and released within 21 days after capture, but preferably within seven days (particularly if the test eels are from out-of-basin).

   All telemetered eels will be radio and passive integrated transponder (PIT) tagged. PIT antennas will be installed at bypasses at Vernon and Bellows Falls and monitored continuously to verify passage of eels via bypass channels.

   <u>Vernon Project Route Selection Study</u>:
   A minimum number of 50 telemetered eels (e.g., 5 separate groups of approximately 10 eels each) will be required to maximize the data return. Tagged eels should be released at least 5 km upstream of the Vernon project. Groups of

eels should be released during spill and non-spill periods if possible. Telemetry receivers and antennas should be located to assess passage via the following potential routes: Vernon spillway; Fishway attraction water intake (if operational); Vernon downstream bypasses; and Vernon Station turbines.

Eels from the Bellows Falls route studies migrating to the Vernon Dam may be used to supplement (but not serve in lieu of) these release groups.

<u>Bellows Falls Dam Route Selection Study:</u>
A minimum number of 50 telemetered eels (e.g., 5 separate groups of approximately 10 eels each) will be required to maximize the data return. Groups of eels should be released during spill (if any) and non-spill and during periods of low, moderate, and high generation conditions, if possible. Tagged eels should be released at least 5 km upstream of the Bellows Falls Dam. If significant spillage occurs during releases, up to 50 additional eels should be released in the upper canal and allowed to volitionally descend through the canal to assure that sufficient number of eels are exposed to canal and powerhouse intake conditions. Telemetry receivers and antennas should be located upstream and downstream of the spillway, at the canal entrance, within the canal, in the fish downstream fish bypass entrance and turbine intakes and in mainstem below Bellows Falls Station to assess passage via the following potential routes: entrainment into the canal; passage over the spillway; into the upstream fishway attraction water intake (this should operated during the study to assess its use by eels as it may be operational in the future for riverine or eel passage as addressed in the Resident Fish Passage study request); the downstream fish bypass; and station turbines.

Eels from the Wilder route study migrating to the Bellow Falls Project may be used to supplement (but not serve in lieu of) these release groups.

<u>Wilder Project Route Selection Study:</u>
A minimum number of 50 telemetered eels (e.g., 5 separate groups of approximately 10 eels each) should be required to maximize the data return. Tagged eels should be released at least 5 km upstream of the Wilder Project. Groups of eels should be released during spill and non-spill periods if possible. Telemetry receivers and antennas should be located to assess passage via the following potential routes: Wilder spillway; Fishway attraction water intake (if operational); Wilder downstream bypasses; and Wilder Station turbines.

Mobile tracking (i.e., via boat) in river reaches between release sites and several km downstream of Vernon Station will be performed at regular intervals during and after releases to confirm routes and fates of passed fish, or fish lost to follow-up.

Movement rates (time between release and detection at radio antenna locations, and between radio antenna locations) of eels passing the projects by various routes will also be quantified.

The route selection portion of this study should occur in both study years.

2. **Objective 2: Spill, Bypass, and Turbine Mortality/Injury Studies**
Spill, bypass, and turbine mortality will be assessed using a radio-telemetric balloon tag method. A minimum number of 50 tagged eels (e.g., 5 separate groups of approximately 10 eels each) will be required at each location (dam spillways, downstream bypasses, and station turbines) to maximize the data return.

For spill mortality sites (dam spillways and downstream bypasses), tagged eels will be injected or released into spill flow at points where water velocity exceeds 10 ft/sec, to minimize the possibility of eels swimming upstream into the headpond or canal. Passed balloon-tagged eels will be recovered below areas of spill and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged eels will be censored from the data.

For turbine mortality sites (Vernon, Bellows Falls, and Wilder stations), tagged eels will be injected into intakes of units operating at or near full generation at points where intake water velocity exceeds 10 ft/sec, to minimize the possibility of eels swimming back upstream through the intakes. Passed balloon-tagged eels will be recovered in the tailrace and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged eels will be censored from the data.

If the balloon tag mortality component of the study occurs in Study Year 1 then all possible route selection sites would need to be evaluated. If the balloon tag mortality component of the study occurs in Study Year 2, then results from the route selection study (Year 1) could be used to inform which sites need to be evaluated for mortality.. Eels recovered from balloon tag studies should not be used for route selection studies.

Data analyses of route selection and turbine mortality (instantaneous and latent) will follow standard methodology.

Project operation (flows, levels, gate openings, number of units operating and operation level) and environmental conditions (river flow, temperature, turbidity, air temperature, precipitation) will be monitored regularly (hourly measurements if possible) throughout the duration of the studies.

These methodologies are consistent with accepted practice.

Level of Effort/Cost, and Why Alternative Studies will not suffice

The level of cost and effort for the downstream eel passage study would be moderate to high; silver eels would need to be collected, tagged, and released in several locations over the course of the migration season. Antennas and receivers would need to be installed at the intakes of all stations as well as at the dam spillways and Station bypasses, and monitored regularly. Data would need to be retrieved periodically, then analyzed. A multi-site route selection study conducted by the USGS Conte Lab on the Shetucket River in Connecticut cost approximately $75,000 for the first year of study.

The applicant did not propose any studies to meet this need in the PAD.

References:

Brown, L.S. 2005. Characterizing the downstream passage behavior of silver phase American eels at a small hydroelectric facility. M.Sc. Thesis, Department of Natural Resource Conservation, University of Massachusetts, Amherst, Massachusetts. 110 pp.

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Study Request 10: In-stream Flow Habitat Assessment Downstream of Wilder, Bellows Falls, and Vernon Dams (Docket Number p-1904) (Docket Number p-1855) (Docket Number p-1892)

Goals and Objectives

The goal of this study is to determine an appropriate flow regime that will protect and enhance the aquatic resources below the Wilder, Bellows Falls, and Vernon projects. Specifically, the objective of this study is to conduct an instream flow habitat study to assess the impacts of the range of proposed project discharges on the wetted area and optimal habitat for key species.

The study should include non-steady flow approaches to assess effects of within-day flow fluctuations due to peaking power operations on target fish species and benthic invertebrate communities. Target species will include but are not limited to: American shad, fallfish, white sucker, yellow perch, smallmouth bass, walleye, and dwarf wedge mussel.

Resource Management Goals

The New Hampshire Fish and Game Department (NHFGD) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

- Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.

- Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to aquatic resources, the NHFGD's goals are:

- Protect, enhance, or restore diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.

- Provide an instream flow regime that meets the life history requirements of resident and migratory fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

Existing Information

The distance from the upstream end of the Wilder impoundment downstream to the Vernon dam is 120 miles. A total of 97 miles (81%) of this segment is impounded. The remaining riverine habitat is within the 17 miles downstream of Wilder dam and the 6 miles downstream of Bellows Falls. At the scoping meetings, FirstLight also indicated that their project assessment may provide evidence that the upstream extent of the Turners Falls impoundment may not reach all the way to Vernon Dam. This would suggest that there may be additional riverine habitat for a presently unknown distance below the Vernon project.

The Wilder, Bellows Falls, and Vernon projects are each operated as daily peaking facilities. Total hydraulic capacity of each facility is 12,700, 11,010, and 12,634 cfs, respectively. Each of the PADs for these projects indicate that "Generation can vary during the course of any day between the required minimum flow and full capacity if higher flows are available" (p. 2-28, p. 2-29, and p. 2-30 in the Wilder, Bellows Falls and Vernon PADs, respectively). Regular daily fluctuations on the order of 9,000 cfs or greater are commonly recorded at USGS gages 01144500 (Connecticut River at West Lebanon, below Wilder Dam) and 01154500 (Connecticut River at North Walpole, NH, below Bellows Falls Dam). Required minimum flows are 675, 1,083, and 1,250 cfs (or inflows if less) for each facility, respectively, though in practice minimum flows are operated as 700, 1300, and 1600 cfs, respectively. The PADs for these projects do not indicate how these minimum flow requirements were established or what specific ecological resources they are intended to benefit. The NHFGD is not aware of any previously conducted studies that have evaluated the adequacy of this minimum flow in protecting aquatic resources in the 23+ miles of riverine habitat below these projects, nor project effects of daily hydropeaking on riverine habitat. Therefore, in order to fill this important information gap, an empirical study is needed to provide information on the relationship between flow and habitat in the Connecticut River downstream of the Wilder, Bellows Falls, and Vernon projects. Results will be used by the NHFGD to determine an appropriate flow recommendation.

Nexus to Project Operations and Effects

The Wilder, Bellows Falls, and Vernon projects are currently operated with a minimum flow release that was not based on biological criteria or field study. Further, the projects generate power in a peaking mode resulting in substantial within-day flow fluctuations between the minimum and project capacity. The large and rapid changes in flow releases from peaking hydropower dams are known to cause adverse effects on downstream habitat and biota (Cushman 1985, Blinn et al. 1995, Freeman et al. 2001). There are at least 23 miles of lotic (flowing) habitat below the project's discharge that are impacted by peaking operations from these projects. This section of the Connecticut River contains habitat that supports native riverine species, including the federally endangered dwarf wedge mussel, and could include spawning and rearing habitat for migratory fish such as American shad. While the existing licenses of the Wilder, Bellows Falls, and Vernon projects do require a continuous minimum flow of 675, 1,083, and 1,250 cfs, respectively, we do not believe this flow sufficiently protects the aquatic resources, including endangered species, of these river reaches, especially in the context of the magnitude, frequency, and duration of changes in habitat that likely occur due to hydropeaking operations.

Results of the flow study will be used by the NHFGD to determine an appropriate flow recommendation that will protect and/or enhance the aquatic resources below the Project.

Methodology Consistent with Accepted Practice

In-stream flow habitat assessments are commonly employed in developing operational flow regimes that will reduce the impacts or enhance habitat conditions downstream of hydroelectric projects.

The NHFGD requests a flow study be conducted in the following areas: in the approximately 17 miles between the Wilder Dam and the headwaters of the Bellows Falls pool, in the approximately 6 miles between the Bellows Falls Dam and the headwaters of the Vernon pool, and in the approximately 1.5 miles between Vernon Dam and the downstream end of Stebbins Island (or the upstream extent of the Turners Pool as determined by FirstLight, whichever river length is greater).

Given the length of river reach (23+ miles) impacted by project operations, we believe a study methodology that utilizes an IFIM approach is appropriate for this context. Similar protocols have been used and accepted by FERC in numerous other licensing proceedings.

The study design should involve collecting wetted perimeter, depth, velocity, and substrate data along transects in the deep, straight-channel areas of the specified river reaches mentioned above. Two-dimensional hydraulic modeling should be conducted in the sections of river with more complex features such as islands, braiding, falls, and shallow-water shoals. The measurements should be taken over a range of flows sufficient to model the full extent of the operational flow regime. This information should then be synthesized to quantify habitat suitability (using mutually agreed-upon habitat suitability index (HSI) curves) over a range of flows for target species identified by the fisheries agencies. Data should be collected in such a way that allows a dual-flow analysis and habitat time series or similar approaches that will permit assessment of how quality and location of habitat for target species changes over the range of flows that occur as part of the operational flow regime.

Level of Effort/Cost, and Why Alternative Studies will not suffice

Field work for instream flow studies can be reasonably extensive but will depend on consultation with the applicant on study methodology and on-site decisions on locations for data collection and the number of collection locations. Use of laser measurements, GPS, and/or an Acoustic Doppler Current Profiler (ADCP, if available) can improve efficiency and accuracy of field measurements. Post-fieldwork data analysis would be a moderate cost and effort. We anticipate that the level of effort and costs will be comparable to that of other FERC relicensing projects of similar size to these projects.

Literature Cited

Blinn, W., J.P. Shannon, L.E. Stevens, and J.P. Carder. 1995. Consequences of fluctuating discharge for lotic communities. Journal of the North American Benthological Society 14: 233–248.

Cushman, R.M. 1985. Review of ecological effects of rapidly varying flows downstream from hydroelectric facilities. North American Journal of Fisheries Management 5: 330–339.

Freeman, M.C, Z.H. Bowen, K.D. Bovee, and E.R. Irwin. 2001. Flow and habitat effects on juvenile fish abundance in natural and altered flow regimes. Ecological Applications 11: 179–190.

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Study Request 11: Impacts of Water Fluctuations Downstream of the Vernon, Bellows Falls and Wilder Projects on Resident Fish Spawning (Docket Number p-1904) (Docket Number p-1855) (Docket Number p-1892)

Goals and Objectives

The goal of this study is to determine if the full range of project induced flow and water level fluctuations in the project-affected areas below the Vernon, Bellows Falls and Wilder Dams negatively impact resident fish spawning (smallmouth bass, common white sucker, walleye and fallfish), and if impacts are found to occur, to develop appropriate mitigation measures.

Specific objectives include:

1) Conduct field studies in the project-affected areas downstream from the Vernon, Bellows Falls and Wilder Dams to assess timing and location of fish spawning. Nesting locations should be mapped.

2) Conduct field studies in the Project affected areas below the Vernon, Bellows Falls and Wilder Dams to evaluate potential impacts of the full range of project induced water level fluctuations on nest abandonment, spawning fish displacement and egg dewatering. The study should also evaluate if changes in fluctuation range would mitigate for identified impacts and/or if other mitigative measures would lessen these impacts.

Resource Management Goals

A mission of both the New Hampshire Fish and Game Department (NHFGD) and the Vermont Fish and Wildlife Department is to protect and conserve fish and their habitats. Resident fish species are an important component of the river's ecology and in some cases are the basis for a sport fishery. This requested study will help protect and conserve resident fish species by ensuring Project operations do not negatively impact their spawning success.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1. New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2. New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3. New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.

4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

Existing Information

To our knowledge, no information exists related to this requested study.

Nexus to Project Operations and Effects

Project operations have the potential to impact fish species by influencing spawning success and spawning habitat quality and quantity. For example, flow and water level changes due to Project operations could create conditions where fish eggs are exposed to air, where quality spawning habitat is dewatered, and/or where fish abandon nests containing eggs. A study of a regulated river found temporal fluctuations of streamflow appeared to be the most important abiotic factor determining smallmouth bass nesting success or failure (Lukas and Orth 1995). Similarly, other research suggests stream discharge during and immediately after spawning could be important to smallmouth bass recruitment success (Smith et al. 2005). Current can also impact early survival of walleye by moving eggs and larvae from spawning sites (Humphrey et al. 2012).

Methodology Consistent with Accepted Practice

Common tools to evaluate fish spawning would be used including electrofishing, visual observations, and telemetry. Specific areas of interest are locations in project-affected areas below the Vernon, Bellows Falls and Wilder Dams where it is determined that the before mentioned fish species spawn. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

Level of Effort/Cost, and Why Alternative Studies will not suffice

TransCanada does not propose any studies to meet this need. Estimated cost for the study is moderate.

Literature Cited:

Humphrey, S, Y.M. Zhao and D. Higgs. 2012. The effects of water currents on walleye (Sander vitreus) eggs and larvae and implications for the early survival of walleye in Lake Erie. Canadian Journal of Fisheries and Aquatic Sciences 69: 1959-1967.

Lukas, J.A. and D.J. Orth. 1995. Factors affecting nesting success of smallmouth bass in a regulated Virginia stream. Transactions of the American Fisheries Society 124: 726-735.

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Smith, S.M., J.S. Odenkirk, and S.J. Reeser. 2005. Smallmouth bass recruitment variability and its relation to stream discharge in three Virginia rivers. North American Journal of Fisheries Management 25: 1112-1121.

Study Request 12: Effects of the Wilder and Bellows Falls Projects on the Dwarf Wedgemussel (*Alasmidonta heterodon*) (Docket Number p-1855) (Docket Number p-1892)

Goals and Objectives

It has been well documented that the damming of rivers can have detrimental impacts on the mussel communities that inhabit areas both upstream and downstream of dams (Watters 1999, Layzer et. al. 1993, Moog 1993). The goal of this study is to evaluate the effects that the Wilder and Bellows Falls hydroelectric projects have on populations of the federally-endangered dwarf wedgemussel (*Alasmidonta heterodon*). In addition, the results of the study can be used to develop measures to minimize adverse impacts to the dwarf wedgemussel in the future. The specific objectives of the study are as follows:

Objective 1: Conduct an initial survey of the free flowing stretch of the Connecticut River from the Wilder Dam to the upstream end of the Bellows Falls impoundment to determine the distribution of the dwarf wedgemussel in this reach.

Objective 2: Determine the best sites for intensive quantitative sampling of mussel communities, with emphasis on the dwarf wedgemussel. Data will be collected to estimate density (mussels per unit area) and age class structure for all species.

Objective 3: Lay the groundwork for a long-term monitoring program.

Objective 4: Document instream behavior of mussels during varying flow conditions.

Objective 5: Determine how availability and persistence of dwarf wedgemussel habitat changes with water level and flow fluctuations.

Relevant Resource Management Goals

It is the goal of the U. S. Fish and Wildlife Service (USFWS) to recover the dwarf wedgemussel so that it can be removed from the Endangered Species list in the future. According to the Recovery Plan (USFWS 1993), the Connecticut River dwarf wedgemussel population is one that must be demonstrated to be viable in order before the species can be downlisted to threatened. The Upper Connecticut metapopulation is likely the largest remaining population in the world (USFWS 2007), and so its protection is essential to the recovery of the species as a whole.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state’s fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq*.), the Federal Power Act (16 U.S.C. §791a, *et seq*.), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

Existing Information and Need for Additional Information

Existing information

In 2011, Biodrawversity, LLC conducted a freshwater mussel survey throughout the Vernon, Bellows Falls, and Wilder project areas (Biodrawversity and LBG 2012). This survey was semi-quantitative (i.e. timed searches were used) and the main goal was to assess the distribution, abundance, demographics, and habitat of the dwarf wedgemussel in the project areas. Dwarf wedgemussel were found in the Wilder impoundment (all within a 14-mile stretch of the river beginning 27 miles upstream of the Wilder Dam) and Bellows Falls impoundment (located sporadically in the upper 17 miles of the impoundment); none were found in the Vernon project-affected area. These results corroborate the results of other studies performed in the past in these areas (Nedeau 2006a, Nedeau 2006b).

Need for additional information

The 2011 survey did not include the 17-mile free flowing stretch of the Connecticut River downstream of Wilder Dam. The dwarf wedgemussel has, in the past, been found within this river reach, although overall there has been limited survey work in the area. A better understanding of the distribution and abundance of the dwarf wedgemussel in this stretch of the river is required before an evaluation of how the dam affects this species can be made. **This need is represented in Objective 1**.

Since the 2011 survey was semi-quantitative, it cannot be used as a basis for determining population estimates or trends (Wicklow 2005). In fact, few if any of the past surveys performed in the project-affected areas have employed quantitative methodology. In addition, there is little quantitative information regarding the age class structure, and therefore recruitment, of the mussel communities in the area. In order to demonstrate that a dwarf wedgemussel population is viable according to the Dwarf Wedgemussel Recovery Plan (USFWS 1993), it must have a large and dense enough population to maintain genetic variability and annual recruitment must be adequate to maintain a stable population. Thus, knowledge of population size and density as well as a better understanding of age class structure is a necessary step in determining the baseline status of dwarf wedgemussel populations. The 2011 survey and other surveys can be used to determine the best sites for implementing a monitoring program. **This need is represented in Objective 2**.

Once this baseline is established, it will be important to monitor the sites so that biologists can estimate and track changes to dwarf wedgemussel populations and/or evaluate any project-related population impacts. Therefore, there is a need to develop long-term monitoring plots that will be surveyed at regular intervals using methodology that is repeatable and yields quantitative, statistically valid results. **This need is represented in Objective 3**.

Flow conditions that result from dam operations may alter the behavior of individual dwarf wedgemussels or individuals of other species. Dam operations affect streamflow, temperature, and dissolved oxygen, and changes to these variables can often be rapid. It is not known how these rapid changes affect various aspects of a mussel's biology, including lure display, shell position (open/closed), siphoning rate, and vertical migration. **This need is represented in Objective 4**.

Dam operations can also affect the availability of habitat for mussels, and this availability can change quickly as water levels fluctuate under peaking operations. The persistence of habitat is a key element to the long-term success of sedentary lotic organisms such as the dwarf wedgemussel (Maloney et. al. 2012), which is unable to quickly move in response to rapid changes in its environment and can thus become stranded in areas of unsuitable habitat; however, there is currently no information concerning the relation of project operations to habitat persistence within the Wilder and Bellows project-affected areas. **This need is represented in Objective 5**.

Project Nexus

The dwarf wedgemussel is known to occur within the Wilder and Bellows Falls project areas and operations of these two dams may affect the viability of this species in the Connecticut River. This study plan will allow for a better understanding of how sub-daily flow and water level fluctuations influence dwarf wedgemussel abundance, available habitat, and behavior. This information can be used to inform the development of license requirements that can ensure the continued existence of this species within the project-affected areas.

Additionally, a long-term monitoring program of important dwarf wedgemussel sites within the project areas is necessary to evaluate any project-related population and/or behavioral impacts that may occur. This information can be used to inform decision makers in the future.

Proposed Methodology

A survey of the 17-mile reach between the Bellows Falls impoundment and the Wilder Dam is the logical first step of the study plan, and this can be done in well less than one field season. This may be treated as an extension of the Biodrawversity and LBG (2012) survey and the same semi-quantitative methodology may be used. Once completed, this survey will help fill in the knowledge gap that exists in the distribution of the dwarf wedgemussel within this reach of the Connecticut River. **This proposed methodology corresponds to Objective 1**.

Next, quantitative study plots should be established at sites throughout the two project-affected areas that are known to support the dwarf wedgemussel. Plots should be set up and surveyed using methodology that will allow for the estimation of population density and size. Smith et. al. (2001) have developed such a methodology, which is also outlined in Strayer and Smith (2003). It is based on a double-sampling design (visual inspection of the substrate surface plus excavation of a random subset of quadrats) using 0.25 m^2 quadrats that are placed systematically with multiple random starts. This protocol has been used to monitor dwarf wedgemussel populations at two sites on the Ashuelot River in Keene, NH (Nedeau 2004). A number of other recent studies have also made use of this protocol for different species of mussels (Fulton et. al. 2010, Crabtree & Smith 2009, Bradburn 2009).

Data to determine age class structure should also be collected at these selected sites. This would involve measuring the length and estimating the age (through external annuli counts) of each mussel sampled within a quadrat. Based on this information, an analysis of recruitment can be made. This field work and analysis was performed on the mussel community inhabiting the lower Osage River in Missouri as part of the relicensing process of the Osage Hydroelectric Project (FERC no. 459) (ESI 2003). The work done on the Osage can be used as a template for this study. Depending on how many plots are chosen, this phase of the study could take one or two field seasons. **This proposed methodology corresponds to Objective 2**.

The sites surveyed to meet Objective 2 should be resurveyed using the same methodology at regular intervals in the future so that any changes over time and/or over varied flow regimes can be evaluated. In addition, a mark-recapture pilot study should be initiated to evaluate the potential for using this methodology for long-term monitoring of dwarf wedgemussel abundance and survival. Mark-recapture methods provide statistically robust estimates of population parameters that are superior to simple count estimates in cases where it is not practicable to count all individuals in a population. Methods should be similar to those in Peterson et al. (2011), Meador et al. (2011), and Villella et al. (2004), but should focus on differences among sampled sites. Sites should be selected based on those sampled to meet Objective 2, but should also include sites outside of the project area to fully evaluate project effect and to account for any natural variability that may be independent of project effect.

A long-term mussel monitoring program was devised as part of the study plan for the relicensing of the Lake Blackshear Hydroelectric Project (FERC no. 659) on the Flint River in Georgia. According to the monitoring plan (Lake Blackshear Project 2009), three surveys will be conducted five years apart, beginning five years after issuance of the FERC license. Surveys will be quantitative (there is a qualitative aspect to the Lake Blackshear mussel monitoring plan that can be ignored) and will focus on evaluating changes in recruitment and population size of the purple bankclimber (*Elliptoideus sloatianus*), a federally-listed species. A similar protocol should be used to monitor dwarf wedgemussel populations in the project-affected areas of the Connecticut River post-license, although the number of surveys and the time between surveys may require some research and discussion. **This proposed methodology corresponds to Objective 3**.

In order to investigate the effects that the hydropower projects have on mussel behavior, individual mussels should be observed as flow fluctuates as a result of dam operations. Researchers should measure changes in shell position (open/closed), siphoning rate, lure display, horizontal migration (movement across the substrate), and vertical migration (burrowing). Past studies have quantified changes in vertical migration due to flow fluctuations (Saha & Layzer 2008, DiMaio & Corkum 1997). This phase of the study will likely take two field seasons in order to maximize the number of behavioral observations so that any trends can be identified and evaluated. **This proposed methodology corresponds to Objective 4**.

At these same sites, an evaluation of flow fluctuations on dwarf wedgemussel habitat persistence should be conducted following methods similar to those of Maloney et. al. (2012). This will include the development of a two-dimensional hydrodynamic model based on modeled depth, velocity, Froude number, shear velocity, and shear stress. This model will be used to quantify suitable dwarf wedgemussel habitat and its persistence over a range of flows, including flows typically experienced under peaking operations. These methods are being employed to evaluate persistence of dwarf wedgemussel habitat on the Delaware (Maloney et. al. 2012) and Susquehanna (T. Moburg, The Nature Conservancy, personal communication) rivers. Depending on how many plots are chosen, this phase of the study could take one or two field seasons. **This proposed methodology corresponds to Objective 5**.

Level of Effort and Cost

The cost for collecting the data for this study is entirely dependent on the number of study sites selected, as well as how frequently surveys will be conducted as part of the long-term monitoring plan. The expected level of effort and anticipated costs will be comparable to that of similar FERC relicensing projects of this size.

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Study Request 13: Determine the Fish Assemblage in Vernon, Bellows Falls and Wilder Project-Affected Areas (Docket Number p-1904) (Docket Number p-1855) (Docket Number p-1892)

Goals and Objectives

The goal of this study request is to determine the occurrence, distribution, and relative abundance of fish species present in the project-affected areas of the Vernon, Bellows Falls and Wilder Projects, which potentially includes Species of Greatest Conservation Need (SGCN) for both New Hampshire and Vermont.

Specific objectives include:
1) Document fish species occurrence, distribution and abundance within the project-affected areas along spatial and temporal gradients.

2) Compare historical records of fish species occurrence in the project-affected areas to results of this study.

Resource Management Goals
A mission of both the New Hampshire Fish and Game Department (NHFGD) and the Vermont Fish and Wildlife Department is to protect and conserve fish and their habitats. Riverine fish species are an important component of the river's ecology and are the basis for the sport fishery. Furthermore, several of the states' SGCN have been documented in the project-affected area.

Determining species occurrence, distribution and abundance will help address research and monitoring needs for species whose populations are poorly known. For example, as outlined in Vermont's Wildlife Action Plan (Kart et al.2005), research and monitoring needs for SGCN include monitoring and assessing populations and habitats for current conditions and future changes, and identifying and monitoring problems for species and their habitats.

A study that aims to provide a comprehensive investigation that documents which fish species are utilizing the project-affected areas in relation to spatial, temporal and environmental gradients (i.e. temperature, dissolved oxygen, pH, turbidity) will allow for a fuller understanding and examination of potential impacts that the Vernon, Bellows Falls and Wilder Project's operations have on the species that reside there. As noted below, there is little information concerning riverine fish in the project-affected areas as related to this study request.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1. New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2. New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3. New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4. Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest
The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

Existing Information
A thorough and comprehensive assessment of the fish assemblage present in the project-affected areas of the Bellows Falls and Wilder Projects is lacking. The PAD for the Bellows Falls Project acknowledges that, "Little comprehensive information is available regarding characterization of the fish community in relation to the Project." The PAD for the Wilder Project states, "No targeted studies have been conducted to characterize the fish community in relation to the Project."

The most relevant fish study related to the Bellows Falls and Wilder project-affected areas is a Connecticut River electrofishing survey conducted in 2008 (Yoder et al., 2009). While some sampling was conducted in both project-affected areas during the 2008 survey, this survey did not have the same goals and objectives as those outlined above. Additionally, both the Bellows Falls and Wilder PADs acknowledged that fish species assemblage data are limited and that the synthesized data may not be a full representation of species occurrence in the project-affected areas. Although, fish data has been collected by Vermont Yankee for many years in the Vernon Dam project-affected area, objectives and methodology for those fish surveys differ from those stated here, and gear types were generally limited to boat electrofishing which may not be suitable for properly assessing all species present in the project-affected areas. It is unknown if other species may inhabit or utilize aquatic habitats in the projects area that to this date have not been documented by previous surveys. It follows that without more information on the fish community in the project-affected areas, project impacts on fish species are also unknown.

Nexus to Project Operations and Effects

Project operations have the potential to directly impact fish species life history requirements, biological interactions, and habitat quantity and quality. For example, headpond and tailwater water level fluctuations could dewater important spawning areas or change available habitat, thus limiting productivity of important game fish species by direct impacts to their spawning success or indirectly by limiting the spawning success of forage fish species. Furthermore, several of New Hampshire and Vermont's SGCN have been documented in the project-affected area. Accordingly, a thorough understanding of the current fish assemblage structure and associated metrics are needed in order to examine any potential project-related impacts.

It should be noted that the NHFGD does periodically conduct fish surveys on the Connecticut River in the vicinity of these projects. However, past surveys were not spatially wide spread enough nor conducted in a short enough time frame to meet the goals and objectives of this study request.

Methodology Consistent with Accepted Practice

An accepted and robust field sampling design (e.g., as described in Pollock et al. 2002 or MacKenzie et al. 2006) and accepted methods for collecting fish species likely to be present in the project-affected areas (Bonar et al. 2009) should be used to conduct field surveys. Randomly sampling multiple habitat types using a multi-gear approach will be required to ensure that all fish species present are sampled. The spatial scope of the study will be from the most upstream area influenced by the Wilder Dam to the most downstream area influenced by the Vernon Project. Sampling should occur at each selected site across multiple seasons (spring, summer, and fall). Digital photographs should be taken to avoid misidentifying certain species such as Cyprinids.

The sampling design should include replicate samples for estimation of species detection probability. Sample replicates may be gathered temporally, using different methods, by independent observers, or by randomly sampled spatial replicates (MacKenzie et al. 2006). For each replicate sample, data that may be important for describing variation in species occurrence and presence/absence should be collected and recorded, such as gear type, mesohabitat type, depth, velocity, flow, water temperature, substrate, time of day, day of year, presence of cover, proportion of vegetation cover, size of individuals collected (juveniles may select different habitat), and other factors as determined by a qualified biologist. Species detection, occurrence, and/or abundance as related to these parameters should be estimated using methods as described by Kery et al. (2005), MacKenzie et al. (2006), Wenger and Freeman (2008), or Zipkin et al. (2010).

Based on first year study results, specific studies examining impacts of project operations on specific fish species may be requested. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

Level of Effort/Cost, and Why Alternative Studies will not suffice

The cost of the study will be moderate to high as seasonal sampling with several types of gear will be required. However, cost will also be partially dependent on the number of sites sampled, the number of sample replicates, and the extent of the covariate data that are measured. Provided the collected data are of high quality, analysis and synthesis should take approximately 10-20 days. TransCanada did not propose any studies specifically addressing this issue

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Study Request 14: Model River Flows and Water Levels Upstream and Downstream from the Wilder, Bellows Falls, and Vernon Stations and Integration of Project Modeling with Downstream Project Operations (Docket Number p-1904) (Docket Number p-1855) (Docket Number p-1892)

Goals and Objectives

The goal of this study is to develop river flow models that permit the evaluation of the hydrologic changes to the river caused by the physical presence and operation of the Wilder, Bellows Falls, and Vernon Hydroelectric Projects and the interrelationships between the operation of all five hydroelectric projects up for relicensing and river inflows. Specific objectives of this study include:

1. Conduct quantitative hydrologic modeling of the hydrologic influences and interactions that exist between the water surface elevations of the Wilder, Bellows Falls, and Vernon project impoundments and discharges from the Wilder, Bellows Falls, and Vernon projects and the downstream hydroelectric projects including:
    a. Inflows into the Wilder, Bellows Falls, and Vernon impoundments from the Fifteen Mile Falls Project, FERC No. 2007, and other sources;
    b. Existing and potential discharges from the Wilder, Bellows Falls, and Vernon project generating facilities and spill flows, including existing and potential minimum flow and other operational requirements;
    c. Existing and potential water level fluctuation restrictions (maximum and minimum pond levels) of the Wilder, Bellows Falls, and Vernon impoundments, and consequent changes in downstream project discharges; and
    d. Incorporation of the potential effects of climate-altered flows on project operations over the course of the license.
2. Assess how existing and potential operations of the Wilder, Bellows Falls, and Vernon projects affect the operations of the Northfield Mountain and Turners Falls Projects, including:
    a. How Wilder, Bellows Falls, and Vernon flow fluctuations affect pool levels of the Turners Falls impoundment; and
    b. How operations of the Wilder, Bellows Falls, and Vernon projects affect Turners Falls discharges.

Resource Management Goals

The New Hampshire Fish and Game Department (NHFGD) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to aquatic resources, the NHFGD's goals are:

1. Protect, enhance, or restore, diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Provide an instream flow regime that meets the life history requirements of diadromous fish and resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize current and potential negative project operation effects on water quality and aquatic habitat.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest
The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

Existing Information
Available information in the PAD does not indicate how project operations have altered the hydrology downstream from each of these facilities, which may affect resident and migratory fish, macroinvertebrates, rare, threatened and endangered species, aquatic plants and other biota

and natural processes in the Connecticut River. It is also unclear how operations at one facility affect the operations at another.

Nexus to Project Operations and Effects

The Wilder, Bellows Falls, and Vernon projects are each currently operated with required minimum flows of 675, 1,083, and 1,250 cfs (or inflows if less) for each facility, respectively, though in practice minimum flows are operated as 700, 1300, and 1600 cfs, respectively. There is presently no required minimum flow for the bypassed reach of the Bellows Falls Project. Each of the projects operates as a daily peaking facility, such that "Generation can vary during the course of any day between the required minimum flow and full capacity if higher flows are available" (p. 2-28, p. 2-29, and p. 2-30 in the Wilder, Bellows Falls and Vernon PADs, respectively). Total hydraulic capacity of each facility is 12,700, 11,010, and 12,634 cfs, respectively. Regular daily fluctuations on the order of 9,000 cfs or greater are commonly recorded at USGS gages 01144500 (Connecticut River at West Lebanon, below Wilder Dam) and 01154500 (Connecticut River at North Walpole, NH, below Bellows Falls Dam). Daily fluctuations in headpond elevation are approximately 2.5' (382' to 384.5' MSL), 1.2' (289.9' to 291.1' MSL), and 1.2' (218.6' to 219.8' MSL) at the Wilder, Bellows Falls, and Vernon impoundments, respectively.

These described changes affect biotic habitat and biota upstream and downstream of each project. Project operations and potential changes to operations to mitigate impacts at each facility are influenced by inflows and operations of upstream projects. Results of river flow analyses will provide necessary information regarding changes that can be made to the Wilder, Bellows Falls, and Vernon Project flow releases and/or water level restrictions, how such changes may be constrained by inflows and upstream project operations, and how these changes potentially affect downstream resources. This information will then be used to develop flow-related license requirements and/or other mitigation measures.

Methodology Consistent with Accepted Practice

River hydrology statistics and hourly flow modeling are commonly employed at hydroelectric projects to assess implications of project operations on the river environment.

Level of Effort/Cost, and Why Alternative Studies will not suffice

Level of effort and cost of model development are expected to be moderate as much of the baseline modeling has already been completed, but running of various scenarios through the model(s) will be needed throughout the relicensing process to assess the implications of changes to the operations of each project on other projects and other resources. The modeling exercise will also require coordination and cooperation between TransCanada and the downstream licensee to assure that the model inputs and outputs can be accurately related.

We would anticipate that the expected level of effort and anticipated costs will be comparable to that experienced on similar FERC relicensing projects of this size (e.g., Conowingo, FERC No. 405).

Literature Cited:

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 15: Impacts of Water Level Fluctuations on Aquatic Vegetation, Including Invasive Species, in the Vernon, Bellows Falls and Wilder Project Impoundments and Riverine Reaches (Docket Number p-1904) (Docket Number p-1855) (Docket Number p-1892)

Goals and Objectives

The goal of this study is to determine if the full range of water level fluctuations from the Vernon, Bellows Falls and Wilder Hydroelectric Projects negatively impact emergent aquatic vegetation (EAV) and submerged aquatic vegetation (SAV) and their habitats in the impoundments and riverine reaches below the dams.

The objective is to conduct field studies in mainstem littoral zones, tributaries and backwaters to determine if EAV and SAV species distribution and abundance, and their habitats, are impacted by current water level fluctuations permitted under the TransCanada Projects' licenses and whether aquatic vegetation and its habitats can be enhanced by modifications to project operations or other mitigation measures and whether there is any unique or important shoreline or aquatic habitats that should be protected. Results of this study may also be used to help determine the adequacy of existing downstream minimum flow requirements.

The specific objectives of the field study, at a minimum, include:

- Quantitatively describe and map wetland types within 200 feet of the shoreline, and describe associated wildlife;
- Delineate, quantitatively describe, and map all wetland types including invasive species and wildlife observed (e.g., bald eagle nesting, water fowl nesting) within 200 feet of the shoreline, and the extent of this habitat if it extends beyond 200 feet; and
- Quantitatively describe (e.g., substrate composition, vegetation type and abundance) and map shallow water aquatic habitat types subject to project operation inundation and exposure, noting and describing additional areas where water depths at lowest operational range are wetted to a depth less than one foot (flats, near shore areas, gravel bars, with very slight bathymetric change);

A second year of study may be required should river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

The field study should produce a habitat inventory report that includes:

- The results of the field study in the form of maps and descriptions;
- An assessment of project effects on wetland, riparian, littoral zone vegetation and shallow water habitats, invasive plant species, and wildlife habitat at the project; and
- Recommendations for any necessary plant, habitat type, or wildlife, protection and/or invasive species control measures.

Resource Management Goals

A mission of both the New Hampshire Fish and Game Department (NHFGD) and the Vermont Fish and Wildlife Department is to protect and conserve fish and their habitats. Riverine fish species are an important component of the river's ecology and in some cases are the basis for a sport fishery. Aquatic vegetation is crucial fish habitat as the majority of fish in the project impoundments utilize EAV and SAV at some point during their life history. This requested study will help enhance EAV and SAV in the project impoundments.

The New Hampshire Department of Environmental Services is responsible for ensuring that surface water quality standards are met in all surface water bodies. The surface water quality criteria for Biological and Aquatic Community Integrity (Env-Wq 1703.19) are:

(a) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.
(b) Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

Aquatic vegetation, such as EAV and SAV, is an important component of the ecology of the Connecticut River. Aquatic vegetation in the areas affected by the project should be studied to demonstrate compliance with Env-Wq 1703.19.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

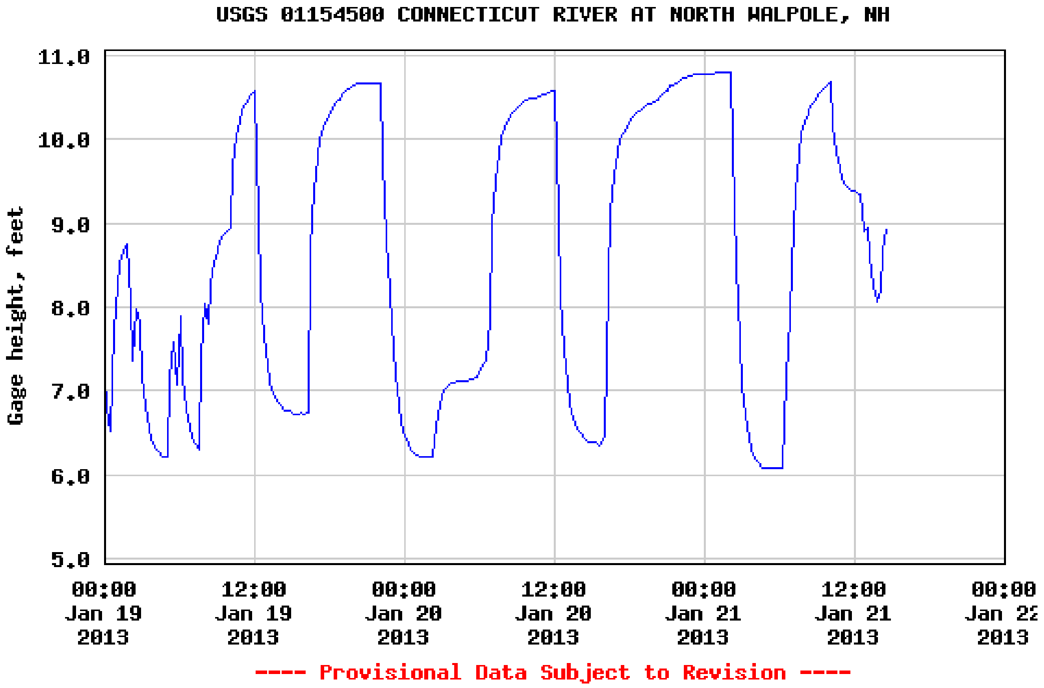
The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

Existing Information

Existing information in the PADs does not quantify EAV and SAV. However, the applicant acknowledges that water level fluctuations caused by the project have the potential to affect fringing wetland and littoral areas:

> "*The average daily water level fluctuation of 2.5 vertical feet has resulted in a zone of sparse vegetation along most of the shorelines of the impoundment. Wetland and littoral resources in this zone are limited by the frequent wetting and drying.*" (Wilder PAD, p.3-104, see also similar language in the Bellows Falls PAD p. 3-115 and the Vernon PAD p. 3-143)

An example of the water level fluctuations that occur in the Lower Connecticut River due to hydropower generation is shown below.



Nexus to Project Operations and Effects

Water level fluctuations due to project operations have the potential to influence fish species life history requirements, biological interactions, and habitat quantity and quality by impacting EAV and SAV. For example, water level changes due to project operations could create conditions where EAV and SAV abundance is diminished, thus negatively impacting a habitat used by riverine fish for spawning, rearing, feeding, and cover. Additionally, water level fluctuations due to project operations could influence EAV and SAV habitat in the project impoundments and promote invasive plants over native species. This study needs to take into account existing and potential future limits on impoundment level fluctuations intended to limit recreation impacts, and the interactions of any changes in pond level fluctuation range or frequency and discharge changes.

Methodology Consistent with Accepted Practice

Vegetation mapping and mapping of littoral zones in relation to water level fluctuations are common tools for identifying EAV and SAV that may be impacted by changes in water levels. The study should include field surveys designed to describe the characteristics of each mapped wetland, riparian, littoral and shallow water habitat including plant species composition, relative abundance/density, habitat quality, and land use. These surveys should be conducted to describe these habitats at the lowest water level operational range permitted on a daily operation schedule, under low flow conditions. Information collected should include:

- Plant species composition, and their relative abundance/density and condition/structure (e.g., seedlings)
- Surveying for the federally Endangered Northeastern bulrush (*Scirpus ancistrochaetus*);
- Structured data, including estimates of average heights and aerial cover of each vegetation layer (specifically denoting invasive species);
- Aquatic habitat substrate composition, quantity (i.e., percent types and area), wood structure (relative abundance measure applied by area), water depths (inundated, exposed, and water less than one foot);
- Predominate land use(s) associated with each cover type;
- Wildlife sightings should be noted;
- Field verified wetland, riparian, and littoral and shallow water habitats and invasive species occurrences, should be geo-referenced as polygons and overlain on orthophoto at a suitable scale.
- Identification (mapped location, total area) of any EAV, SAV or other fish habitat (i.e. wood, rocks, etc) that is dewatered at the lowest water level operational range permitted on a daily operation schedule, under low flow conditions.

Bathymetric mapping of the littoral zone will be needed to model the extent of this zone that will be affected by different water fluctuation scenarios.

The study area is from the most upstream area influenced by the Wilder Dam to the most downstream area influenced by the Vernon Dam. Water level fluctuations caused by the projects may affect not only the impoundments, but also the downstream river reaches below the dams. Studies would occur in the main river littoral zone and in backwater areas during spring, summer and fall. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

Level of Effort/Cost, and Why Alternative Studies will not suffice

Although the PAD's acknowledge that project operations have the potential to impact littoral resources, TransCanada did not propose any studies concerning aquatic vegetation. Analysis as described above is needed to understand potential impacts of the projects on these resources. Estimated cost for the study is moderate due to the need for field assessment.

Literature Cited:

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 16: Impacts of the Vernon, Bellows Falls and Wilder Project Impoundment Water Fluctuations on Resident Fish Spawning (Docket Number p-1904) (Docket Number p-1855) (Docket Number p-1892)

Goals and Objectives

The goal of this study is to determine if the full range of water level fluctuations in the Vernon, Bellows Falls and Wilder Hydroelectric Projects negatively impact resident fish species (smallmouth bass, largemouth bass, yellow perch, black crappie, common sunfish, bluegill, chain pickerel, northern pike, golden shiner, common white sucker, spottail shiner, walleye and fallfish) in the impoundments, and if impacts are found to occur, to develop appropriate mitigation measures.

Specific objectives include:

1) Conduct field studies in the mainstem, tributaries and backwaters of project affected areas to assess timing and location of fish spawning. Nesting locations should be mapped.

2) Conduct field studies in the mainstem, tributaries and backwaters of project-affected areas to evaluate potential impacts of impoundment fluctuation on spawning habitat, nest abandonment, spawning fish displacement and egg dewatering. The study should also evaluate if changes in impoundment fluctuation range would mitigate for identified impacts and if other mitigative measures would lessen these impacts.

Resource Management Goals

A mission of both the New Hampshire Fish and Game Department (NHFGD) and the Vermont Fish and Wildlife Department is to protect and conserve fish and their habitats. Resident fish species are an important component of the river's ecology and in some cases are the basis for a sport fishery. This requested study will help protect and conserve resident fish species by ensuring project operations do not negatively impact their spawning success.

The New Hampshire Department of Environmental Services is responsible for ensuring that surface water quality standards are met in all surface water bodies. The surface water quality criteria for Biological and Aquatic Community Integrity (Env-Wq 1703.19) are:

(a) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.
(b) Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

Resident riverine fish are important components of the ecology of the Connecticut River. Fish populations and habitats in the areas affected by the project should be studied to demonstrate compliance with Env-Wq 1703.19.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1. New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2. New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3. New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4. Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

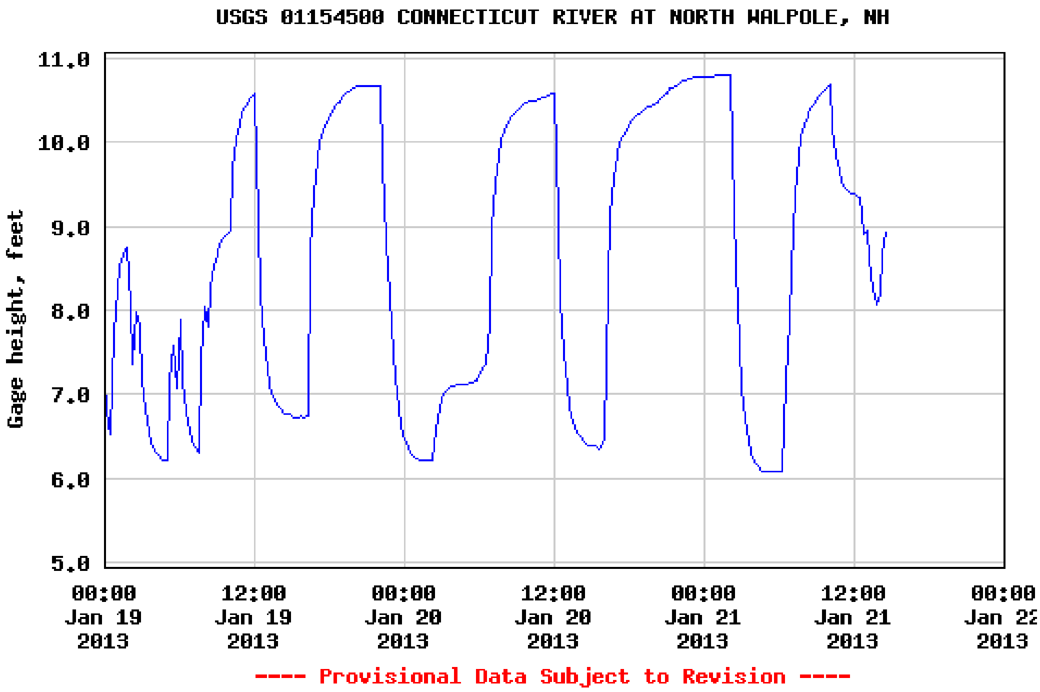
Public Interest

The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

Existing Information

To our knowledge, no information exists related to this requested study.

An example of the water level fluctuations that occur in the Lower Connecticut River due to hydropower generation is shown below.



Nexus to Project Operations and Effects

Project operations have the potential to impact fish species by influencing spawning success and spawning habitat quality and quantity. For example, water level changes due to project operations could create conditions where fish eggs are exposed to air, where quality spawning habitat is dewatered, and/or where fish abandon nests containing eggs. The New Hampshire Fish and Game Department has received several calls in past springs regarding "acres" of yellow perch eggs being dewatered in the Bellows Falls Impoundment.

The projects operate within normal, permitted and flood-condition reservoir fluctuation limits that include during high flow events, the dropping of stantion bays that cannot be raised without a subsequent drawdown of the impoundment beyond normal project operating ranges. The full range of reservoir fluctuations, including periodic drawdowns for stantion bay replacement, need to be addressed in this study.

Methodology Consistent with Accepted Practice

Common tools to evaluate fish spawning and habitat would be used including, but not limited, electrofishing, visual observations, telemetry and habitat measurements. The study area for this request includes all impounded waters, including tributaries and backwaters, within the project-affected areas of the Vernon, Bellows Falls and Wilder Hydroelectric Projects. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

Level of Effort/Cost, and Why Alternative Studies will not suffice
TransCanada does not propose any studies to meet this need. Estimated cost for the study is moderate to high but is dependent on the amount of field study that is needed.

Literature Cited:

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 17: Impacts of the Vernon, Bellows Falls and Wilder Project Operations on Tributary and Backwater Area Access and Habitats. (Docket Number p-1904) (Docket Number p-1855) (Docket Number p-1892)

Goals and Objectives

One goal of this study is to determine if water level fluctuations from the Vernon, Bellows Falls and Wilder Hydroelectric Projects result in a barrier(s) to fish movement in and out of tributaries and backwaters to the impoundments and riverine reaches below dams.

A second goal is to determine if water level fluctuations in the Vernon, Bellows Falls and Wilder Project impoundments impact water levels, available fish habitat and water quality in tributaries and backwaters to the impoundments and riverine reaches below dams, and if impacts are found, to ascertain how spatially far reaching they are and develop mitigation measures.

Results of this study may also be used to help determine the adequacy of existing downstream minimum flow requirements.

Specific objectives include:
1) Conduct a field study of tributaries and backwaters, including water velocity and habitat data where appropriate, to evaluate potential impacts of impoundment fluctuation on fish access to tributaries and backwater areas. The study should also evaluate if changes in impoundment fluctuation range would mitigate for any identified impacts and if other mitigative measures would improve access.

2) Conduct a field study to examine potential impacts of impoundment fluctuations on water levels, available habitat and water quality in tributaries and backwaters. The evaluation should also evaluate if changes in impoundment fluctuation range would mitigate for identified impacts and if other mitigative measures would lessen these impacts.

Resource Management Goals

A mission of both the New Hampshire Fish and Game Department (NHFGD) and the Vermont Fish and Wildlife Department is to protect and conserve fish and their habitats. Diadromous and resident riverine fish species are an important component of the river's ecology and in some cases are the basis for a sport fishery. Furthermore, two of the states' Species of Greatest Conservation Need (SGCN) that would potentially be impacted have been documented in the project-affected areas.

The New Hampshire Department of Environmental Services is responsible for ensuring that surface water quality standards are met in all surface water bodies. The surface water quality criteria for Biological and Aquatic Community Integrity (Env-Wq 1703.19) are:

a) The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.
b) Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

Diadromous and resident riverine fish are important components of the ecology of the Connecticut River. Fish populations and habitats in the areas affected by the Project should be studied to demonstrate compliance with Env-Wq 1703.19.

This requested study will help promote tributary and backwater access and protect valuable fish habitat and maintain appropriate water quality conditions for diadromous and riverine fish species in project-affected areas. Maintaining connectivity between the mainstem of the Connecticut River and tributaries and backwaters is vital to the fish populations in these systems, as many fish species utilize these areas for spawning, rearing, refuge, and feeding.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

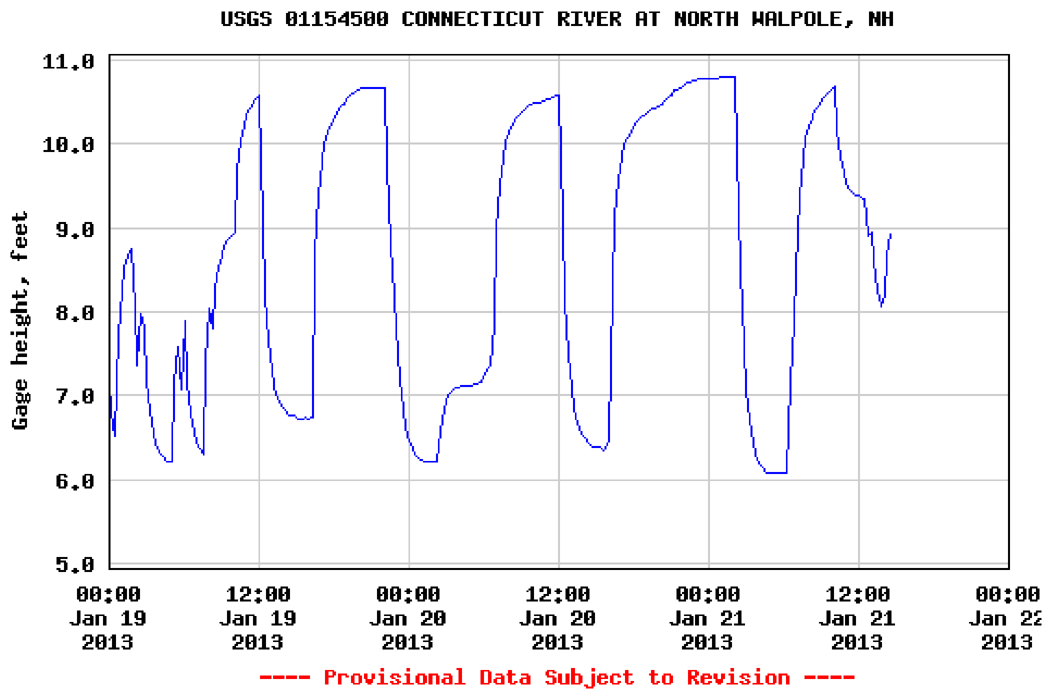
Public Interest

The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

Existing Information

To our knowledge, no information exists related to this requested study.

An example of the water level fluctuations that occur in the Lower Connecticut River due to hydropower generation is shown below.



Nexus to Project Operations and Effects

Project operations have the potential to impact fish species life history requirements, biological interactions, and habitat quantity and quality. For example, water level changes due to project operations could create conditions that could impede free movement of fish between tributaries/backwaters and the mainstem of the Connecticut River, thus limiting access to spawning habitat and/or growth opportunities. Additionally, water level changes could also alter tributary and backwater fish habitat quality, quantity, and also water quality, thus decreasing productivity and available habitat. Furthermore, two of New Hampshire and Vermont's SGCN that could be impacted have been documented in the project-affected areas.

Methodology Consistent with Accepted Practice

Common tools to evaluate water level impacts would be used including: bathymetric mapping, substrate, depth and velocity measurements, and water quality information (dissolved oxygen, temperature, turbidity, and pH). Studies should be conducted throughout the year.

The study area for tributary and backwater fish sampling should cover all tributaries and backwaters within the project-affected areas of the Vernon, Bellows Falls and Wilder Hydroelectric Projects. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

Level of Effort/Cost, and Why Alternative Studies will not suffice

TransCanada does not propose any studies to meet this need. Estimated cost for the study is relatively low.

Literature Cited:

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 18: Impingment and Entrainment of Resident Fish Species at the Wilder, Bellows Falls and Vernon Intakes (Docket Number p-1904) (Docket Number p-1855) (Docket Number p-1892)

Goals and Objectives

The goal of this study is to assess the adequacy of the intakes at Bellows Falls, Wilder, and Vernon projects to minimize fish mortality resulting from impingement and entrainment of resident fishes residing in the Connecticut River, and to recommend appropriate mitigative measures as necessary.

Specific objectives include:

- Describe the configuration of the intake at each project, including the forebay characteristics, size of the intakes, trashrack spacing and extent of coverage if the intakes, approach velocities and the influence of trashrack debris and cleaning protocols..
- Estimate the mortality rates for resident fish species and life stages that may result from impingement on project trashracks.
- Estimate the mortality rates for resident fish species and life stages that may result from entrainment and passage through the project turbines. Review existing Vermont Fish and Wildlife Department's (VTFWD) fish passage data to increase sample size and gain a better understanding of temporal variability.
- Determine structural and operational measures that could be reduce resident fish mortality.

Resource Management Goals

Vermont Water Quality Standards (VWQS) seek to provide high quality aquatic habitat necessary to support healthy aquatic communities and the associated uses such as fishing.

The Vermont Fish and Wildlife Department's goals related to aquatic natural resources and pertinent to this study request are to:

1. Provide for healthy, self-sustaining fish communities.

2. Minimize the potential negative effects of project operation on resident fish populations, and mitigate for losses.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

Existing Information

The Connecticut River and the project impoundments support a variety of resident fish species as well as angling. However, there is no information about resident fish mortality and the population effects resulting from project impingement and entrainment. The project PADs contain almost no information about the project trashracks. During the ILP site visits held in October 2012 the Agency was informed that the rack spacing was in most cases four inches (on center) and as much as six inches in some cases. Further, these trashracks do not cover the entire intake area in all cases. No information on approach velocities has been provided. Mortality rates of resident fish passing through the turbines are not known.

Nexus to Project Operations and Effects

The Bellows Falls, Wilder and Vernon dams span across the Connecticut River, acting as a physical impediment to fish passage. Fishes living in the impoundments will at times enter project forebays and come in close proximity to project intakes. Impingement or entrainment is certainly occurring but the extent of this impact is unknown. The wide rack spacing is likely to result in entrainment.

The projects include downstream fish passage facilities but their use and effectiveness for resident fish species is unknown. These facilities are operated seasonally and therefore will not mitigate impingement and entrainment at all times.

Methodology Consistent with Accepted Practice

Impingement, entrainment and turbine mortality studies have been conducted at numerous other hydropower projects and can be used to assess potential fish mortality based on results from other projects with similar configurations.

Approach velocities can be calculated and actual measurements can be taken to quantify variability by location and verify calculated results.

Turbine mortality should be assessed by releasing tagged fish for downstream recovery. The details of this type of study should be addressed during the study plan stage.

The contribution of existing downstream fish passage facilities to reducing impingement and entrainment of resident fishes should also be assessed.

Level of Effort/Cost, and Why Alternative Studies will not suffice

The expected level of effort and anticipated costs will be comparable or less than those experienced on similar FERC projects of this size.

Literature Cited:

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 19: Assessment of Adult Sea Lamprey (*Petromyzon marinus)* Spawning within the Wilder, Bellows Falls, and Vernon Project Areas. (Docket Number p-1904) (Docket Number p-1855) (Docket Number p-1892)

Perform a study to investigate potential impacts of the Wilder, Bellows Falls and Vernon Project's operations on sea lamprey spawning success.

Goals and Objectives

Assess the level of spawning activity by sea lamprey in the Wilder, Bellows Falls, and Vernon project areas and determine whether operations of these Projects are affecting the success (i.e survival to emergence) of this activity.

Identify areas within the Wilder, Bellows Falls, and Vernon project areas where suitable spawning habitat exists for sea lamprey.

Conduct a telemetry study of sea lamprey during their upstream migration period in the spring, focusing on areas of suitable spawning habitat, and areas of known spawning.

Conduct spawning ground surveys to observe the utilization of this habitat for spawning purposes, and hence, confirm suitability.

Obtain data on redd characteristics including location, size, substrate, depth and velocity.

Determine if the operations at the Wilder, Bellows Falls and Vernon projects are adversely affecting these spawning areas (i.e. if flow alterations are causing dewatering and/or scouring of sea lamprey redds). If it is determined that the operations of the projects are adversely affecting the spawning success of sea lamprey, identify operational regimes that will reduce and minimize impacts to sea lamprey spawning habitat and spawning success within the project area.

Resource Management Goals

The sea lamprey (*Petromyzon marinus*), within the Connecticut River drainage, is one of New Hampshire and Vermont's Species of Greatest Conservation Need (SGCN). The conservation status of sea lamprey in New Hampshire is listed as "vulnerable." One of the threats identified in Vermont's Wildlife Action Plan (Kart et al. 2005) is degraded spawning habitat, which is second to habitat fragmentation.

As outlined in Vermont's Wildlife Action Plan (Kart et al. 2005), research and monitoring needs for SGCN include monitoring and assessing populations and habitats for current conditions and future changes, and identifying and monitoring problems for species and their habitats.

One of the conservation strategies identified in the Vermont Wildlife Action Plan, is protecting and restoring aquatic and riparian habitats through improved water quality; flow, water level and temperature regimes; sediment reduction; establishment of streamside buffers; and suitable aquatic habitat structure, diversity and complexity.

In support of conservation strategies and research needs listed above, identifying potential impacts that the Wilder, Bellows Falls, and Vernon Projects have on sea lamprey spawning is paramount. Results of the study will be used to develop flow-related license requirements and/or other mitigation measures that will optimize spawning habitat for a New Hampshire and Vermont SGCN.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1. New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2. New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3. New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4. Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest

The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

Existing Information

It is known that sea lamprey spawn in the Connecticut River main stem at least as far upstream as Wilder Dam, as well as tributary waters including the West, Williams, Black and White Rivers (Kart et al. 2005).

The PAD discusses sea lamprey distribution as: "FWS (2012) lists the current upstream extent of sea lamprey range as Bellows Falls Dam, noting, however, that reproduction has been documented as far north as the White River, Vermont, in the Wilder Project area. In certain years hundreds to thousands of sea lamprey have been recorded passing upstream of Bellow Falls dam, and in at least one year (2008) sea lamprey were documented passing upstream via the Wilder Dam fish ladder. In 2008 surveys, Yoder et al. (2009) documented sea lamprey just downstream of the confluence of the White River."

In 2012 at total of 99 sea lamprey were observed passing the Bellows Falls Dam, and a total of 696 sea lamprey were observed passing the Vernon Dam.

To date no studies have been conducted that aim to identify spawning habitat and spawning activity of sea lamprey within in the Wilder, Bellows Falls, and Vernon project areas and whether Project operations are affecting these activities.

Nexus to Project Operations and Effects

The operation of the Wilder, Bellows Falls and Vernon projects including minimum flows and large and rapid changes in flow releases from the dam have the potential to cause direct adverse effects on spawning habitat and spawning activity downstream of the dam. If adult sea lampreys are actively spawning in the project area, it is important to assess whether operations of the projects are having any adverse effects (i.e. dewatering and scouring) on these activities.

Methodology Consistent with Accepted Practice

Although a relatively new practice, the tagging and tracking of adult Pacific lamprey to determine final destination, has been successfully conducted in the Columbia River (Noyes et al. 2012). Similarly, from 2005-2009, radio telemetry was used to determine adult lamprey overwintering and spawning habitats, and spawn timing in the lower Deschutes River Subbasin (Fox et al. 2009).

In Vermont, factors affecting sea lamprey survival were examined (Smith and Marsden 2009). It was found that predation, water currents, and displacement of eggs from the nest, played a role in survival. As part of the Wells Hydroelectric project (FERC No. 2149), Pacific lamprey spawning ground surveys were conducted to determine project effects on spawning success.

In 2010, redd surveys were completed in Shitike and Beaver Creeks to identify recent redds for placement of an experimental redd cap. The purpose of capping lamprey redds was to enumerate emerging larvae and to document timing of emergence with respect to estimated date of redd construction and water temperature (Fox et al. 2010). Therefore, to determine project effects on the spawning success of sea lamprey methods should follow Fox et al. (2010).

Level of Effort/Cost, and Why Alternative Studies will not suffice

The estimated level of effort and costs for this recommended study is expected to be moderate to high. The applicant did not propose any alternative studies in its PAD to address this specific issue.

Literature Cited

Fox, M. J.C. Graham, and S. Frank. 2009. Determining Adult Pacific Lamprey Abundance and Spawning Habitat in the Lower Dechutes River Sub-Basin, Oregon. Department of Natural Resources Confederated Tribes of the Warm Springs Reservation, Oregon

Fox, M. J.C. Graham, and S. Frank. 2010. Determining Adult Pacific Lamprey Abundance and Spawning Habitat in the Lower Dechutes River Sub-Basin, Oregon. Department of Natural Resources Confederated Tribes of the Warm Springs Reservation, Oregon

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department. Waterbury, Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm. (Accesse September 10, 2012).

Le, Bao and S. Kreiter. 2008. An assessment of Adult Pacific Lamprey Spawning within the Wells Project. Wells Hydroelectric Project NO. 2149.

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Noyes, C.J., C.C. Caudill, T.S. Clabough, D.C. Joosten, E.L. Johnson, M.L. Keefer, and G.P. Naughton. 2011. Adult Pacific lamprey migration behavior and escapement in the Bonneville Reservoir and Lower Columbia River monitored using the juvenile salmonid acoustic telemetry system (JSATS). Technical Report 2012-4-Draft

Smith, S. J. and J. E. Marsden. 2009. Factors Affecting Sea Lamprey Egg Survival. North American Journal of Fisheries Management 29:859–868.

Study Request 20: Determine Upstream Passage Needs for Riverine Fish Species in the Bellows Falls, Wilder and Vernon Fishways (Docket Number p-1904) (Docket Number p-1855) (Docket Number p-1892)

Goals and Objectives

The goal of this study is to determine the adequacy of the existing Bellows Falls, Wilder, and Vernon fish ladders in passing riverine species and determine the appropriate operation period for these fishways to pass riverine and diadromous fish.

Specific objectives include:

- Identify the utilization and temporal distribution, of passage through the Bellows Falls, Wilder, and Vernon fishways by riverine and diadromous fish species
- Review existing Vermont Fish and Wildlife Department's (VTFWD) fish passage data to increase sample size and gain a better understanding of temporal variability.
- Operate and monitor the fishways year-round (or until otherwise infeasible) to assess fishway use over a longer period than the fishways have traditionally been operated to:

    1. Determine the appropriate operating windows of the fishways for riverine species

    2. Determine the appropriate operating windows of the fishways for diadromous species such as American eel and sea lamprey.

Resource Management Goals

The VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Vermont's Wildlife Action Plan 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.

2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Vermont Fish and Wildlife Department's Strategic Plan (2002 -2010) focuses towards four major areas of concern: resource conservation, fish and wildlife-based recreation and use, human health and safety, efficient operations, and effective management.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

In order to be consistent with both Department's missions and goals, and to promote healthy fish populations, connectivity within a river system is important. By allowing fish to move through the fishway during different times of the year, and during different life history stages, access to available riverine aquatic habitat is increased. Fish are able to seek the best available habitat and food resources, as well as avoid predator interactions. Furthermore, movement within a river system promotes genetic diversity. Currently upstream resident fish passage at the Bellows Falls, Wilder, and Vernon dams is precluded most of the year due to fishway closure.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest
The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

Existing Information
No such information exists that will allow for a comprehensive assessment of existing year round fishway utilization by resident species. The VTFWD has several years (2007-2012) of seasonal passage data that have not yet been analyzed. These data are in the form of .avi files, but only include the spring and summer months (typically May- July).
The PAD acknowledges that "Resident species have also been recorded using the Bellows Falls and Wilder fish ladder". Those data are available from the Vermont Fish & Wildlife Department. Fish passage video data that have been processed should be available for distribution in the future (Lael Will, Vermont Fish & Wildlife, personal communication)". Although not comprehensive, analysis of these data would assist in filling this data gap.

In 2012, VTFWD staff documented resident species passage at the Vernon fishway. Species observed utilizing the fishway included bluegill (N = 555), common carp (N = 209), channel catfish (N = 37), trout sp. (N = 2), walleye (N = 54), white sucker (N = 102), and American eel

(N =262). However, these analyses were conducted during one year and did not include any monitoring outside of the spring spawning run.

Nexus to Project Operations and Effects

The Bellows Falls, Wilder and Vernon dams span across the Connecticut River, acting as a physical impediment to fish passage. Therefore, the project has a direct impact on fish passage and limits fish from accessing available aquatic habitat located upstream of the dam.
The PAD acknowledges that “river fragmentation can reduce or obstruct fish and aquatic community connectivity and therefore genetic diversity and stock structure. However, those impacts are reduced by the provision of fish passage and the length of the impoundment. Upstream and downstream fish passages, designed for Atlantic salmon, are likely used by other migratory and resident species, providing connectivity; however, fish counts are limited, unknown or unavailable for resident species”. In fact, it is known that riverine and diadromous species use the fishways, but there has been limited analysis of this data and fishway monitoring was limited to spring period.

Therefore, in order to determine the level of riverine fish passage through the existing fishways, and the appropriate operation period for the fishway , review of existing data and , further monitoring of the fishways is warranted.

Methodology Consistent with Accepted Practice

Fishway monitoring has been conducted annually by VTFWD dating back to 1985. Monitoring was focused on Atlantic salmon, American shad and American eel. Resident species were recorded periodically, but were not monitored outside the spring anadromous fish migration period

Fishway monitoring has been used to assess existing and proposed project operations, and to develop appropriate operating windows for fisheries resources.
In addition to fish window count data, monitoring should include monitoring of the hydraulic conditions in the fishways and fishway entrances, and periodic fish observations should be made over the length of the fishways. If count data or observations of the fishways indicate the need for fishway operation changes or for more specific information on fish movement through the fishways, changes to the monitoring plan for year 2 monitoring would need to be implemented.

Level of Effort/Cost, and Why Alternative Studies will not suffice

This study will require video monitoring equipment, appropriate software (e.g. salmon soft), and personal to read to files, and manage the equipment. Some information already exists in the form of .avi files and past count data and are readily available from VTFWD. No other tool (e.g. radio telemetry) is more appropriate or cost effective for these types of assessments. Cost is relatively low.

Literature Cited:

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 21a: Wilder Hydroelectric Project: Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations (Docket Number p-1892)

1. ***Goals and Objectives***

   The goal of this study is to determine how project operations contribute to the shoreline erosion and riverbank failure within the impoundment and downstream of the Wilder Hydro Project.

   The objectives of this study are to:

   1. determine how water level fluctuations within the minimum and maximum operating range and discharges from peaking operations at the Wilder hydroelectric project contribute to shoreline erosion;
   2. identify and determine the effects of shoreline bank erosion and riverbank failure on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.);
   3. identify techniques that could be used to mitigate the effects of project operations or other mitigation techniques that could be developed to reduce on riverbank erosion within the impoundment and downstream of the tailrace.

2. ***Resource Management Goals***

   The Connecticut River is considered Class B water by the states of Vermont and New Hampshire. Vermont lists the section of the Connecticut River below the Wilder dam on the Section 303(d) impaired water list due to flow alterations resulting in the destabilization and eroding of shoreline impairing aquatic life and habitat. In Class B waters, Vermont's water quality standards state that water level fluctuation and flow alterations can only occur to the extent that it supports all uses and does not lead to degradation of the water resource or habitat.

   New Hampshire's surface water quality regulations state that "unless the flows are caused by naturally occurring conditions, surface water quantity shall be maintained at levels adequate to protect existing and designated uses." (Env-Wq 1703.01(d)). The specific New Hampshire water quality criteria for turbidity in Class B waters is not to exceed naturally occurring conditions by more than 10 NTUs (Env-Wq 1703.11).

   A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq*.), the Federal Power Act (16 U.S.C. §791a, *et seq*.), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

3. Public Interest Consideration

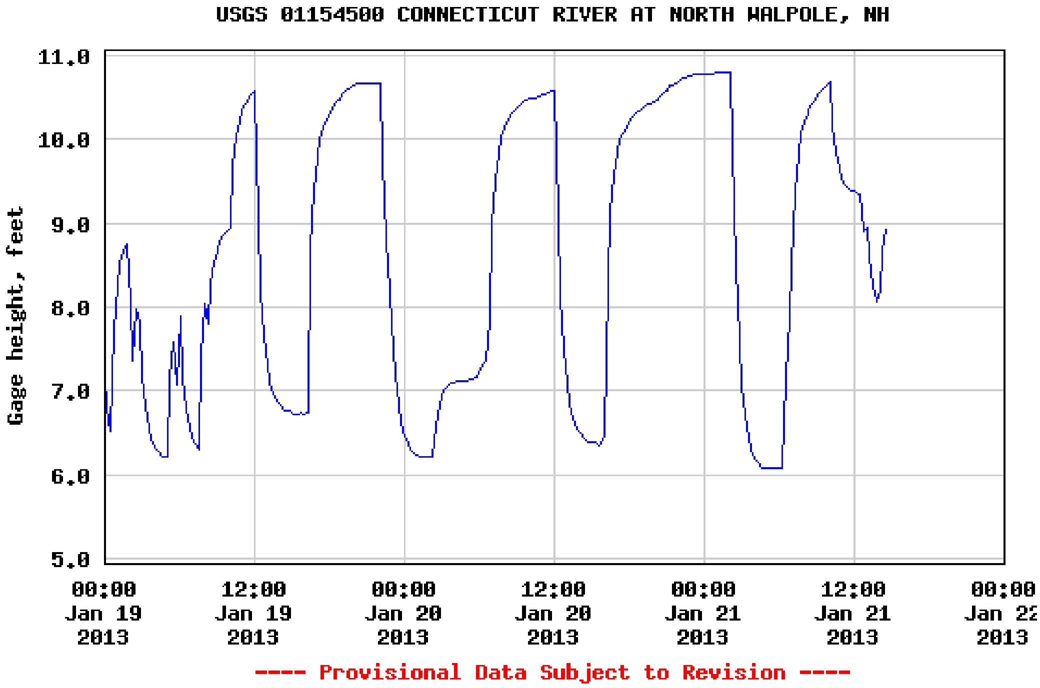
The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

4. Existing Information

The PAD references several studies pertaining to shoreline erosion within the Connecticut River, including a study by US Army Corp of Engineers (Simion et al. 1979). This study evaluated the shoreline within the Wilder impoundment and identified water level fluctuation and periodic high flow events as causes of shoreline erosion. The PAD also discusses the erosion survey that TransCanada initiated in 2010 to inventory sites where erosion is occurring within the Wilder impoundment (Kleinschmidt 2011). Bank slumping was identified as the major type of shoreline erosion within the project impoundment. Bank slumping can occur when fluvial erosional forces known as soil piping are acting on the toe of the bank slope, increasing the angle between the slope of the bank and water surface. The PAD did not address how project related operations contribute to shoreline erosion, could be changed to mitigate impacts on shoreline erosion, or discuss the impacts of shoreline erosion on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.).

Repetitive water level fluctuations and flow alterations caused by hydroelectric peaking operations are known to be a major contributor to shoreline erosion (Lawson 1985). Sediment from shoreline erosion and riverbank failure is one of the major contributors negatively affect water quality and habitat by increasing the turbidity and sedimentation, smothering aquatic habitat in United States. Vermont Surface Water Management Strategy identifies sediment from excessive channel erosion as a stressor on Vermont water and aquatic habitat. Additionally, Vermont lists this section of the Connecticut River on the Vermont Section 303(d) impaired water list due to flow alterations resulting from the destabilization and eroding of shoreline impairing aquatic life and habitat.

An example of the water level fluctuations that occur in Lower Connecticut River due to hydropower generation is shown below.



5. ***Project Nexus***

Wilder Hydroelectric Project operations currently result in daily water level fluctuation in the impoundment by as much as 2.5 feet, which affects shoreline erosion in the impoundment by increasing the rate of soil piping. The project is currently permitted to water level fluctuation in the impoundment by 5 feet. Additionally the project “peaking” operation could contribute to bank erosion downstream of the dam by increasing the shear stress on the bank toe. Furthermore, river profile operations during high flow events minimize overland flow by drawing down impoundment prior to high flows containing high velocity flows to the river channel, possibly increasing shoreline erosion rate within the impoundment. TransCanada is not proposing any changes to project operations.

6. ***Proposed Methodology***

The NHFGD recommends TransCanada complete a study similar to the study completed by Kleinschmidt (2011). The study should be designed to build on erosion survey that was previously completed by determining the process causing erosion at a site, the extent erosion is negatively affecting other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.), and determining how erosion could be stabilized or mitigated by changing project operations. This study can be completed performing the following tasks.

Task 1: Determine erosion and riverbank failure process at identified sites

Shoreline erosion areas and riverbank failure sites were identified during the Kleinschmidt (2011) survey. Erosion sites that were identified during the previous survey should be revisited when the water level in the impoundment is at its lowest elevation, to collect information on erosion forces acting on the site, document if any additional erosion has occurred, and identified new sites of erosion within the impoundment. Erosion processes will be determined by field observations and applying site appropriate geology, geomorphic and hydrological principles. For each erosion site, the following erosion process element will be identified by determining soil type and subsoil characteristics (i.e. depth to bedrock, texture, rock content, signs of soil piping), reservoir water levels at the time of observation, water level fluctuation, climatic conditions, ground water seepage, wind-driven waves, boat waves, and recreation. Additional site characteristic to identify and record in the erosion survey will include but not be limited to an estimate of the length and average height of the erosional area, slope of the site, dominant vegetation cover types present, associated vegetation cover types present, an ocular estimate of total plant cover and total cover by plant class (tree, shrub, herbaceous) in surrounding undisturbed areas. Data from each shoreline erosion site will be recorded on a field form and entered into a database. In addition, a photograph or photographs will be taken of each site. Completion of this evaluation will allow for a determination as to whether the erosion is Project related, and if so, how Project operations may be impacting the site.

Task 2: Determining the effects of erosion on other resources

The effects of shoreline erosion and riverbank failure on other resources should be determined. This will required coordination between studies to determine the effects of erosion on riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, and recreation. Erosion sites identified as having an impact on resources will be assess to determine if project operations are causing erosion and a mitigation plan to protect the resource of interest should be developed.

Task 3: Development of a Shoreline Management Plan

The information that is collected during the study should be used to develop a Shoreline Management Plan for the impoundment. Sites that are determined to impact important resources should be further evaluated to determine if there is a feasible way to reduce or stabilize the area. This feasibility analysis will be based on field observations and knowledge of current erosion control and slope failure stabilization methods that may be suitable for the site. The analysis will provide a preliminary list of potential control measures necessary to reduce erosion at these sites. Detailed analyses for final design and construction of erosion and slope stabilization control measures will not be part of the study. As part of this process, the landowner should be identified for each of the erosion site and future mitigation and stabilization techniques should be presented.

The study area for the shoreline erosion study should extend from the upstream end of the impoundment above the Wilder Dam to the beginning of the impoundment below the Wilder Dam. Water level fluctuations caused by the Project may affect not only the impoundment but also the downstream river reaches below the dam.

7. ***Level of Effort and Cost***

The cost and effort of this study will be moderate, but is important to document the potential impact project operations on shoreline erosion and riverbank failure, and to determine how this may impact other resources.

Literature Cited

Kleinschmidt (Kleinschmidt Associates, Inc.). 2011. Lower Connecticut River Shoreline Survey Report – 2010: Bellows Falls Project (FERC No. 1855), Wilder Project (FERC No. 1892), Vernon Project (FERC No. 1904). Draft Report March 2011. Prepared for TransCanada Hydro Northeast Inc.,Westborough, MA.

Lawson, D.E., 1985, Erosion of northern reservoir shores: An analysis and application of pertinent literature: US Army Corps of Engineers Cold Regions Research and Engineering Laboratory Monograph 85-1, 198 p.

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Simons, D.B., Andrews, J.W., Li, R.M., and Alawady, M.A. 1979. Connecticut River Streambank Erosion Study Massachusetts, New Hampshire, and Vermont. Prepared for

USACE, New England Division.

Study Request 21b: Bellows Falls Hydroelectric Project: Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations (Docket Number p-1855)

1. ***Goals and Objectives***
   The goal of this study is to determine how project operations contribute to the shoreline erosion and riverbank failure within the impoundment and downstream of the Bellows Falls Hydroelectric Project.

   The objectives of this study are to:
   1. determine how water level fluctuations within the minimum and maximum operating range and discharges from peaking operations at the Wilder hydroelectric project contribute to shoreline erosion;
   2. identify and determine the effects of shoreline bank erosion and riverbank failure on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.);
   3. identify techniques that could be used to mitigate the effects of project operations or other mitigation techniques that could be developed to reduce on riverbank erosion within the impoundment and downstream of the tailrace.

2. ***Resource Management Goals***
   The Connecticut River is considered Class B water by the states of Vermont and New Hampshire. Vermont list the section of the Connecticut River above and below Bellows Falls dam on the Section 303(d) impaired water list due to flow alterations resulting in the destabilization and eroding of shoreline impairing aquatic life and habitat. In Class B waters, Vermont's water quality standards state that water level fluctuation and flow alterations can only occur to the extent that it supports all uses and does not lead to degradation of the water resource or habitat. New Hampshire's surface water quality regulations state that "unless the flows are caused by naturally occurring conditions, surface water quantity shall be maintained at levels adequate to protect existing and designated uses." (Env-Wq 1703.01(d)). The specific New Hampshire water quality criteria for turbidity in Class B waters is not to exceed naturally occurring conditions by more than 10 NTUs (Env-Wq 1703.11).

   A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1) New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2) New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3) New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq*.), the Federal Power Act (16 U.S.C. §791a, *et seq*.), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

3. ***Public Interest Consideration***

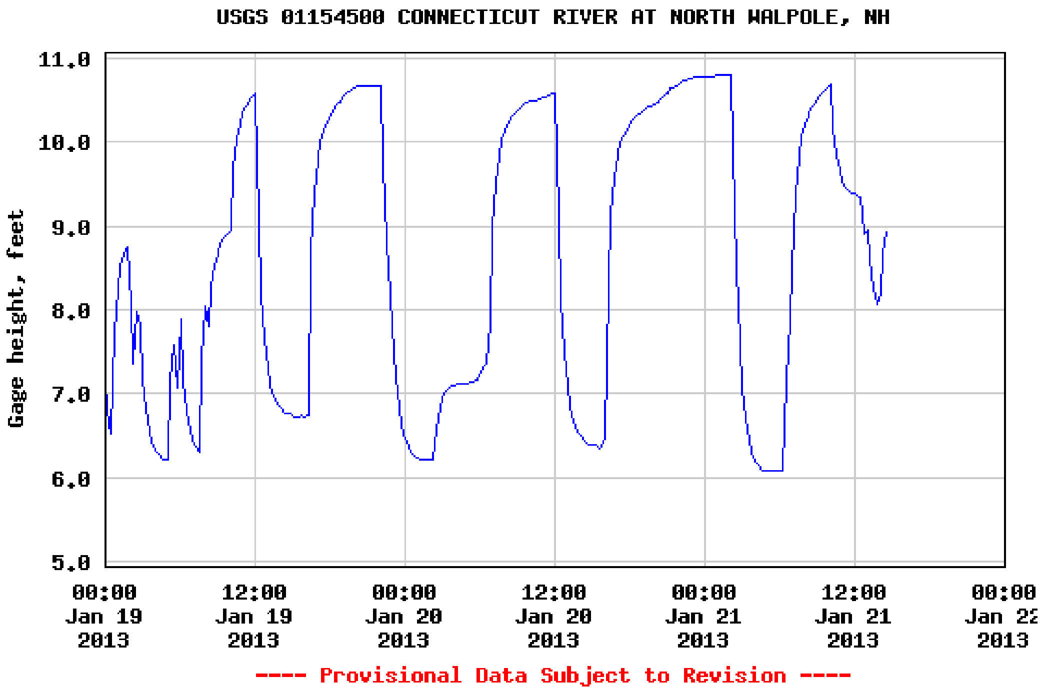
The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

4. ***Existing Information***

The PAD references several studies pertaining to shoreline erosion within the Connecticut River, including a study by US Army Corp of Engineers (Simion et al. 1979). This study evaluated the shoreline within the Wilder impoundment and identified water level fluctuation and periodic high flow events as causes of shoreline erosion. The PAD also discusses the erosion survey that TransCanada initiated 2010 to inventory sites where erosion is occurring within the Bellows Falls impoundment (Kleinschmidt 2011). Bank slumping was identified as the major type of shoreline erosion within the project impoundment. Bank slumping can occur when fluvial erosional forces known as soil piping are acting on the toe of the bank slope, increasing the angle between the slope of the bank and water surface. The PAD did not address how project related operations contribute to shoreline erosion, could be changed to mitigate impacts on shoreline erosion, or discuss the impacts of shoreline erosion on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.).

Repetitive water level fluctuations and flow alterations caused by hydroelectric peaking operations are known to be a major contributor to shoreline erosion (Lawson 1985). Sediment from shoreline erosion and riverbank failure is one of the major contributors negatively affect water quality and habitat by increasing the turbidity and sedimentation, smothering aquatic habitat in United States. Vermont Surface Water Management Strategy identifies sediment from excessive channel erosion as a stressor on Vermont water and aquatic habitat. Additionally, Vermont lists this section of the Connecticut River on the Vermont Section 303(d) impaired water list due to flow alterations resulting from the destabilization and eroding of shoreline impairing aquatic life and habitat.

An example of the water level fluctuations that occur in Lower Connecticut River due to hydropower generation is shown below.



5. ***Project Nexus***

Bellows Falls Hydroelectric Project operations currently result in daily water level fluctuation in the impoundment by approximately 2 feet, which affects shoreline erosion in the impoundment by increasing the rate of soil piping. The project is currently permitted to water level fluctuation in the impoundment by 3 feet. Additionally the project “peaking” operation could contribute to bank erosion downstream of the dam by increasing the shear stress on the bank toe. Furthermore, river profile operations during high flow events the project impoundment is operated to minimize overland flow by drawing down impoundment prior to high flows containing high velocity flows to the river channel, possibly increasing shoreline erosion rate within the impoundment. TransCanada is not proposing any changes to project operations.

6. ***Proposed Methodology***

The NHFGD recommends TransCanada complete a study similar to the study completed by Kleinschmidt (2011). The study should be designed to build on erosion survey that was previously completed by determining the process causing erosion at a site, the extent erosion is negatively affecting other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.), and determining how erosion could be stabilized or mitigated by changing project operations. This study can be completed performing the following tasks.

Task 1: Determine erosion and riverbank failure process at identified sites

Shoreline erosion areas and riverbank failure sites were identified during the Kleinschmidt (2011) survey. Erosion sites that were identified during the previous survey should be revisited when the water level in the impoundment is at its lowest elevation, to collect information on erosion forces acting on the site, document if any additional erosion has occurred, and identified new sites of erosion within the impoundment. Erosion processes will be determined by field observations and applying site appropriate geology, geomorphic and hydrological principles. For each erosion site, the following erosion process element will be identified by determining soil type and subsoil characteristics (i.e. depth to bedrock, texture, rock content, signs of soil piping), reservoir water levels at the time of observation, water level fluctuation, climatic conditions, ground water seepage, wind-driven waves, boat waves, and recreation. Additional site characteristic to identify and record in the erosion survey will include but not be limited to an estimate of the length and average height of the erosional area, slope of the site, dominant vegetation cover types present, associated vegetation cover types present, an ocular estimate of total plant cover and total cover by plant class (tree, shrub, herbaceous) in surrounding undisturbed areas. Data from each shoreline erosion site will be recorded on a field form and entered into a database. In addition, a photograph or photographs will be taken of each site. Completion of this evaluation will allow for a determination as to whether the erosion is Project related, and if so, how Project operations may be impacting the site.

Task 2: Determining the effects of erosion on other resources

The effects of shoreline erosion and riverbank failure on other resources should be determined. This will required coordination between studies to determine the effects of erosion on riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, and recreation. Erosion sites identified as having an impact on resources will be assess to determine if project operations are causing erosion and a mitigation plan to protect the resource of interest should be developed.

Task 3: Development of a Shoreline Management Plan

The information that is collected during the study should be used to develop a Shoreline Management Plan for the impoundment. Sites that are determined to impact important resources should be further evaluated to determine if there is a feasible way to reduce or stabilize the area. This feasibility analysis will be based on field observations and knowledge of current erosion control and slope failure stabilization methods that may be suitable for the site. The analysis will provide a preliminary list of potential control measures necessary to reduce erosion at these sites. Detailed analyses for final design and construction of erosion and slope stabilization control measures will not be part of the study. As part of this process, the landowner should be identified for each of the erosion site and future mitigation and stabilization techniques should be presented.

The study area for the shoreline erosion study should extend from the upstream end of the impoundment above the Bellows Falls Dam to the beginning of the impoundment below the Bellows Falls Dam. Water level fluctuations caused by the Project may affect not only the impoundment but also the downstream river reaches below the dam.

7. ***Level of Effort and Cost***
The cost and effort of this study will be moderate, but is important to document the potential impact project operations on shoreline erosion and riverbank failure, and to determine how this may impact other resources.

Literature Cited

Kleinschmidt (Kleinschmidt Associates, Inc.). 2011. Lower Connecticut River Shoreline Survey Report – 2010: Bellows Falls Project (FERC No. 1855), Wilder Project (FERC No. 1892), Vernon Project (FERC No. 1904). Draft Report March 2011. Prepared for TransCanada Hydro Northeast Inc.,Westborough, MA.

Lawson, D.E., 1985, Erosion of northern reservoir shores: An analysis and application of pertinent literature: US Army Corps of Engineers Cold Regions Research and Engineering Laboratory Monograph 85-1, 198 p.

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Simons, D.B., Andrews, J.W., Li, R.M., and Alawady, M.A. 1979. Connecticut River Streambank Erosion Study Massachusetts, New Hampshire, and Vermont. Prepared for USACE, New England Division.

Study Request 21c: Vernon Hydroelectric Project: Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations (Docket Number p-1904)

1. ***Goals and Objectives***

   The goal of this study is to determine how project operations contribute to the shoreline erosion and riverbank failure within the impoundment and downstream of the Vernon Hydroelectric Project.

   The objectives of this study are to:

   1. determine how water level fluctuations within the minimum and maximum operating range and discharges from peaking operations at the Wilder hydroelectric project contribute to shoreline erosion;
   2. identify and determine the effects of shoreline bank erosion and riverbank failure on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.);
   3. identify techniques that could be used to mitigate the effects of project operations or other mitigation techniques that could be developed to reduce on riverbank erosion within the impoundment and downstream of the tailrace.

2. ***Resource Management Goals***

   The Connecticut River is considered Class B water by the states of Vermont and New Hampshire. Vermont lists the section of the Connecticut River above and below Vernon dam on the Section 303(d) impaired water list due to flow alterations resulting in the destabilization and eroding of shoreline impairing aquatic life and habitat. In Class B waters, Vermont's water quality standards state that water level fluctuation and flow alterations can only occur to the extent that it supports all uses and does not lead to degradation of the water resource or habitat. New Hampshire's surface water quality regulations state that "unless the flows are caused by naturally occurring conditions, surface water quantity shall be maintained at levels adequate to protect existing and designated uses." (Env-Wq 1703.01(d)). The specific New Hampshire water quality criteria for turbidity in Class B waters is not to exceed naturally occurring conditions by more than 10 NTUs (Env-Wq 1703.11).

   A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1) New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2) New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3) New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq*.), the Federal Power Act (16 U.S.C. §791a, *et seq*.), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

3. Public Interest Consideration

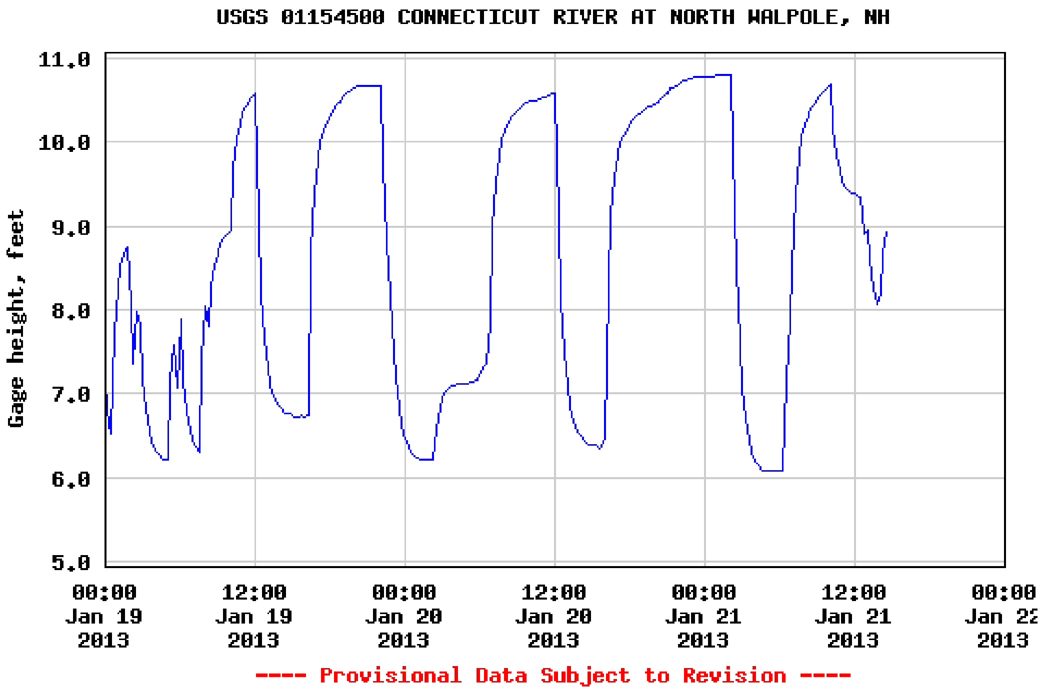
The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

4. Existing Information

The PAD references several studies pertaining to shoreline erosion within the Connecticut River, including a study by US Army Corp of Engineers (Simion et al. 1979). This study evaluated the shoreline within the Wilder impoundment and identified water level fluctuation and periodic high flow events as causes of shoreline erosion. The PAD also discusses the erosion survey that TransCanada initiated 2010 to inventory sites where erosion is occurring within the Vernon impoundment (Kleinschmidt 2011). Bank slumping was identified as the major type of shoreline erosion within the project impoundment. Bank slumping can occur when fluvial erosional forces known as soil piping are acting on the toe of the bank slope, increasing the angle between the slope of the bank and water surface. The PAD did not address how project related operations contribute to shoreline erosion, could be changed to mitigate impacts on shoreline erosion, or discuss the impacts of shoreline erosion on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.).

Repetitive water level fluctuations and flow alterations caused by hydroelectric peaking operations are known to be a major contributor to shoreline erosion (Lawson 1985). Sediment from shoreline erosion and riverbank failure is one of the major contributors negatively affect water quality and habitat by increasing the turbidity and sedimentation, smothering aquatic habitat in United States. Vermont Surface Water Management Strategy identifies sediment from excessive channel erosion as a stressor on Vermont water and aquatic habitat. Additionally, Vermont lists this section of the Connecticut River on the Vermont Section 303(d) impaired water list due to flow alterations resulting from the destabilization and eroding of shoreline impairing aquatic life and habitat.

An example of the water level fluctuations that occur in Lower Connecticut River due to hydropower generation is shown below.



5. ***Project Nexus***

Vernon Hydroelectric Project operations currently result in daily water level fluctuation in the impoundment by approximately 2 feet, which affects shoreline erosion in the impoundment by increasing the rate of soil piping. The project is currently permitted to water level fluctuation in the impoundment by 8 feet. Additionally the project "peaking" operation could contribute to bank erosion downstream of the dam by increasing the shear stress on the bank toe. TransCanada is not proposing any changes to project operations.

6. ***Proposed Methodology***

The NHFGD recommends TransCanada complete a study similar to the study completed by Kleinschmidt (2011). The study should be designed to build on erosion survey that was previously completed by determining the process causing erosion at a site, the extent erosion is negatively affecting other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.), and determining how erosion could be stabilized or mitigated by changing project operations. This study can be completed performing the following tasks.

Task 1: Determine erosion and riverbank failure process at identified sites

Shoreline erosion areas and riverbank failure sites were identified during the Kleinschmidt (2011) survey. Erosion sites that were identified during the previous survey should be revisited when the water level in the impoundment is at its lowest elevation, to collect information on erosion forces acting on the site, document if any additional erosion has occurred, and identified new sites of erosion within the impoundment. Erosion processes will be determined by field observations and applying site appropriate geology, geomorphic and hydrological principles. For each erosion site, the following erosion process element will be identified by determining soil type and subsoil characteristics (i.e. depth to bedrock, texture, rock content, signs of soil piping), reservoir water levels at the time of observation, water level fluctuation, climatic conditions, ground water seepage, wind-driven waves, boat waves, and recreation. Additional site characteristic to identify and record in the erosion survey will include but not be limited to an estimate of the length and average height of the erosional area, slope of the site, dominant vegetation cover types present, associated vegetation cover types present, an ocular estimate of total plant cover and total cover by plant class (tree, shrub, herbaceous) in surrounding undisturbed areas. Data from each shoreline erosion site will be recorded on a field form and entered into a database. In addition, a photograph or photographs will be taken of each site. Completion of this evaluation will allow for a determination as to whether the erosion is Project related, and if so, how Project operations may be impacting the site.

Task 2: Determining the effects of erosion on other resources

The effects of shoreline erosion and riverbank failure on other resources should be determined. This will required coordination between studies to determine the effects of erosion on riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, and recreation. Erosion sites identified as having an impact on resources will be assess to determine if project operations are causing erosion and a mitigation plan to protect the resource of interest should be developed.

Task 3: Development of a Shoreline Management Plan

The information that is collected during the study should be used to develop a Shoreline Management Plan for the impoundment. Sites that are determined to impact important resources should be further evaluated to determine if there is a feasible way to reduce or stabilize the area. This feasibility analysis will be based on field observations and knowledge of current erosion control and slope failure stabilization methods that may be suitable for the site. The analysis will provide a preliminary list of potential control measures necessary to reduce erosion at these sites. Detailed analyses for final design and construction of erosion and slope stabilization control measures will not be part of the study. As part of this process, the landowner should be identified for each of the erosion site and future mitigation and stabilization techniques should be presented.

The study area for the shoreline erosion study should extend from the upstream end of the impoundment above the Vernon Dam to at least the New Hampshire / Massachusetts border. Water level fluctuations caused by the Project may affect not only the impoundment but also the downstream river reaches below the dam.

7. ***Level of Effort and Cost***
The cost and effort of this study will be moderate, but is important to document the potential impact project operations on shoreline erosion and riverbank failure, and to determine how this may impact other resources.

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Study Request 22a: Continuous water temperature monitoring (15 minute intervals) at various locations within the Wilder Hydroelectric Project Impoundment and Tailrace, and Connecticut River downstream of the Wilder Dam (Docket Number p-1892)

Goals and Objectives

The goal of this study is to determine the potential impacts (both project specific and cumulative) of the Wilder Hydroelectric Project operations on hourly/daily temperature fluctuations and spatial thermal distribution within the Wilder Hydroelectric Project Impoundment and Tailrace**,** and the Connecticut River downstream of the Wilder Dam.

The objectives of this study are to:

1. Obtain continuous temperature data (every 15 minutes) at various locations and depths throughout the project impoundment, tailrace, and downstream Connecticut River using temperature loggers;

2. Analyze data for hourly/daily shifts in temperature regime and thermal distribution (aquatic isotherm maps) associated project specific and cumulative impacts associated with project operations; and

3. Determine if any shifts in hourly temperature regime or thermal distribution are impacting aquatic habitat within the project impoundment and tailrace and lower Connecticut River (e.g., thermal blocks to migration, thermal stress, habitat degradation).

Resource Management Goals

Temperature is an important habitat consideration for many aquatic species including migratory fish and rare, threatened, endangered species. Temperature influences the distribution, behavior, metabolism, growth, reproduction, and survival of fishes (Diana 2004). The Connecticut River is considered a Class B waters cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Additionally the Vermont Water Quality Standards states that in Class B cold water fish habitat, the total increase in from any activity or discharge should not result in a temperature increase that exceeds 1.0°F.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state’s fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD’s 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest
The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.
Existing Information
The PAD provides limited information on impacts of project operations ("daily run-of-river") on temperature in the project impoundment, tailrace or lower Connecticut River. Hourly/daily temperature shifts associated with project operations at Wilder Dam can impact aquatic habitat rendering it unsuitable for some organisms. The information in the PAD does not define the spatial extent of temperatures (aquatic isotherm map) within the impoundment, lower Connecticut River. The PAD mainly indicates that in general, temperature did increase from upstream to downstream while dissolved oxygen decreased, reflecting the impacts of the impoundment.

Nexus to Project Operations and Effects
The project impounds 45 miles of river that would otherwise be free flowing. It currently operates in a peaking mode, with allowable impoundment fluctuations of up to 5 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (675 cfs). Water temperature can be affected by the operating mode of a hydropower project. The impounded water increases the water surface area of the river reach containing the project. The increased surface acts as a large solar radiation collector and the thermal mass of the impounded water acts a heat sink storing heat from solar radiation. At night the increased surface area may act as convective radiator that releases heat. Together these attributes may contribute to unnatural thermal properties in the project impoundment that may impact natural temperature regime and influence habitat conditions for fish, wildlife and plant resources (temperature tolerance, life cycle timing (e.g., reproduction or migration), and food availability).

The project discharges regulated Connecticut River flows ("daily run-of-river") from the impoundment to the downstream seventeen mile reach of the Connecticut River. The project can sporadically release large volumes of impoundment water that may be of a different temperature than the receiving water downstream of the dam. Unnatural and rapid shifts in temperature regimes in the downstream water can impact fish, wildlife and plant resources and instream habitat. The NHFGD requests that more recent temperature data is collected in a more intensive, systematic and scientific manner in order to assess project specific and cumulative impacts on fish, wildlife and plant resources at the project. Results from this study may be used to directly inform the evaluation of project effects on related resources, such as a fish and other aquatic species.

Methodology Consistent with Accepted Practice

Use of temperature loggers to gain information on thermal trends has been a standard technique to look at impacts of water storage associated with hydroelectric projects. We recommend that transects be established in the upper, middle, and lower project impoundment, as well as in the tailrace and downstream project. An additional transect should be established in the free flowing section of river above the impoundment to serve as a "reference site". Inexpensive temperature loggers should be deployed along each transects at a minimum of three locations: at depths of 1 meter subsurface, mid-depth, and 1 meter off the bottom (on buoy lines) where water depths permit. The temperature loggers should be deployed from April 1 – November 15 and be set to record temperature at 15 minute intervals. The temperature loggers should be checked and the data downloaded on the monthly basis. The data from the loggers should then be used to develop hourly/daily aquatic isotherm maps, and temperature change and distribution as a result of project and cumulative impacts should be assessed.

Level of Effort/Cost, and Why Alternative Studies will not suffice

The effort and cost of this study is expected to be moderate to high, but the potential project specific and cumulative thermal alteration impacts have never been studied in a comprehensive manner and their potential impacts to aquatic habitat and fish, wildlife, and resources has not been adequately studied.

Literature Cited

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NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 22b: Continuous water temperature monitoring (15 minute intervals) at various locations within the Bellows Falls Hydroelectric Project Impoundment and Tailrace, and Connecticut River downstream of the Bellows Falls Dam (Docket Number p-1855)

Goals and Objectives

The goal of this study is to determine the potential impacts (both project specific and cumulative) of the Bellows Falls Hydroelectric Project operations on hourly/daily temperature fluctuations and spatial thermal distribution within the Bellows Falls Hydroelectric Project Impoundment and Tailrace**,** and the Connecticut River downstream of the Bellows Falls Dam.

The objectives of this study are to:

1. Obtain continuous temperature data (every 15 minutes) at various locations and depths throughout the project impoundment, tailrace, and downstream Connecticut River using temperature loggers.

2. Analyze data for hourly/daily shifts in temperature regime and thermal distribution (aquatic isotherm maps) associated project specific and cumulative impacts associated with project operations.

3. Determine if any shifts in hourly temperature regime or thermal distribution are impacting aquatic habitat within the project impoundment and tailrace and lower Connecticut River (e.g., thermal blocks to migration, thermal stress, habitat degradation).

Resource Management Goals

Temperature is an important habitat consideration for many aquatic species including migratory fish and rare, threatened, endangered species. Temperature influences the distribution, behavior, metabolism, growth, reproduction, and survival of fishes (Diana 2004). The Connecticut River is considered a Class B waters cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Additionally the Vermont Water Quality Standards states that in Class B cold water fish habitat, the total increase in from any activity or discharge should not result in a temperature increase that exceeds 1.0°F.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state’s fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD’s 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1. New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2. New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3. New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4. Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest
The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.
Existing Information
The PAD provides limited information on impacts of project operations ("daily run-of-river") on temperature in the project impoundment, tailrace or lower Connecticut River. Hourly/daily temperature shifts associated with project operations at Bellows Falls Dam can impact aquatic habitat rendering it unsuitable for some organisms. The information in the PAD does not define the spatial extent of temperatures (aquatic isotherm map) within the impoundment, lower Connecticut River. The PAD mainly indicates that in general, temperature did increase from upstream to downstream while dissolved oxygen decreased, reflecting the impacts of the impoundment.

Nexus to Project Operations and Effects
The project impounds 26 miles of river that would otherwise be free flowing. It currently operates in a peaking mode, with allowable impoundment fluctuations of up to 3 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1083 cfs). Water quality can be affected by the operating mode of a hydropower project. The PAD provides limited information on how project operations affect water quality within the project impoundment, bypass reach and tailrace. Water temperature can be affected by the operating mode of a hydropower project. The impounded water increases the water surface area of the river reach containing the project. The increased surface acts as a larger solar radiation collector and the thermal mass of the impounded water acts a heat sink storing heat from solar radiation. At night the increased surface area may act as convective radiator that releases heat. Together these attributes may contribute to unnatural thermal properties in the project impoundment that may impact natural temperature regime and influence habitat conditions for fish, wildlife and

plant resources (temperature tolerance, life cycle timing (e.g., reproduction or migration), and food availability).

The project discharges regulated Connecticut River flows ("daily run-of-river") from the impoundment to the downstream seventeen mile reach of the Connecticut River. The project can sporadically release large volumes of impoundment water that may be of a different temperature than the receiving water downstream of the dam. Unnatural and rapid shifts in temperature regimes in the downstream water can impact fish, wildlife and plant resources and instream habitat. The NHFGD requests that more recent temperature data is collected in a more intensive, systematic and scientific manner in order to assess project specific and cumulative impacts on fish, wildlife and plant resources at the project. Results from this study may be used to directly inform the evaluation of project effects on related resources, such as a fish and other aquatic species.

Methodology Consistent with Accepted Practice

Use of temperature loggers to gain information on thermal trends has been a standard technique to look at impacts of water storage associated with hydroelectric projects. We recommend that transects be established in the upper, middle, and lower project impoundment, as well as in the tailrace and downstream project. An additional transect should be established in the free flowing section of river above the impoundment to serve as a "reference site". Inexpensive temperature loggers should be deployed along each transects at a minimum of three locations: at depths of 1 meter subsurface, mid-depth, and 1 meter off the bottom (on buoy lines) where water depths permit. The temperature loggers should be deployed from April 1 – November 15 and be set to record temperature at 15 minute intervals. The temperature loggers should be checked and the data downloaded on the monthly basis. The data from the loggers should then be used to develop hourly/daily aquatic isotherm maps, and temperature change and distribution as a result of project and cumulative impacts should be assessed.

Level of Effort/Cost, and Why Alternative Studies will not suffice

The effort and cost of this study is expected to be moderate to high, but the potential project specific and cumulative thermal alteration impacts have never been studied in a comprehensive manner and their potential impacts to aquatic habitat and fish, wildlife, and resources has not been adequately studied.

Literature Cited

Diana, J.S. 2004. Biology and Ecology of Fishes. 2nd edition. Biological Sciences Press.

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 22c: Continuous water temperature monitoring (15 minute intervals) at various locations within the Vernon Hydroelectric Project Impoundment and Tailrace, and Connecticut River downstream of the Vernon Dam (Docket Number p-1904)

Goals and Objectives

The goal of this study is to determine the potential impacts (both project specific and cumulative) of the Vernon Hydroelectric Project operations on hourly/daily temperature fluctuations and spatial thermal distribution within the Vernon Hydroelectric Project Impoundment and Tailrace**,** and the Connecticut River downstream of the Vernon Dam.

The objectives of this study are to:

1. Obtain continuous temperature data (every 15 minutes) at various locations and depths throughout the project impoundment, tailrace, and downstream Connecticut River using temperature loggers.

2. Analyze data for hourly/daily shifts in temperature regime and thermal distribution (aquatic isotherm maps) associated project specific and cumulative impacts associated with project operations.

3. Determine if any shifts in hourly temperature regime or thermal distribution are impacting aquatic habitat within the project impoundment and tailrace and lower Connecticut River (e.g., thermal blocks to migration, thermal stress, habitat degradation).

Resource Management Goals

Temperature is an important habitat consideration for many aquatic species including migratory fish and rare, threatened, endangered species. Temperature influences the distribution, behavior, metabolism, growth, reproduction, and survival of fishes (Diana 2004). The Connecticut River is considered a Class B waters cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Additionally the Vermont Water Quality Standards states that in Class B cold water fish habitat, the total increase in from any activity or discharge should not result in a temperature increase that exceeds 1.0°F.

A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state’s fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD’s 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

Public Interest
The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.
Existing Information
The PAD provides limited information on impacts of project operations ("daily run-of-river") on temperature in the project impoundment, tailrace or lower Connecticut River. Hourly/daily temperature shifts associated with project operations at Vernon Dam can impact aquatic habitat rendering it unsuitable for some organisms. The information in the PAD does not define the spatial extent of temperatures (aquatic isotherm map) within the impoundment, lower Connecticut River. The PAD mainly indicates that in general, temperature did increase from upstream to downstream while dissolved oxygen decreased, reflecting the impacts of the impoundment.

Nexus to Project Operations and Effects
The project impounds 26 miles of river that would otherwise be natural free-flowing. It currently operates in a peaking mode, with allowable impoundment fluctuations of up to 8 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1250 cfs). Water temperature can be affected by the operating mode of a hydropower project. The impounded water increases the water surface area of the river reach containing the project. The increased surface acts as a larger solar radiation collector and the thermal mass of the impounded water acts a heat sink storing heat from solar radiation. At night the increased surface area may act as convective radiator that releases heat. Together these attributes may contribute to unnatural thermal properties in the project impoundment that may impact natural temperature regime and influence habitat conditions for fish, wildlife and plant resources (temperature tolerance, life cycle timing (e.g., reproduction or migration), and food availability).

The project discharges regulated Connecticut River flows (“daily run-of-river”) from the impoundment to the downstream seventeen mile reach of the Connecticut River. The project can sporadically release large volumes of impoundment water that may be of a different temperature than the receiving water downstream of the dam. Unnatural and rapid shifts in temperature regimes in the downstream water can impact fish, wildlife and plant resources and instream habitat. The NHFGD requests that more recent temperature data is collected in a more intensive, systematic and scientific manner is needed to assess project specific and cumulative impacts on fish, wildlife and plant resources at the project. Results from this study may be used to directly inform the evaluation of project effects on related resources, such as a fish and other aquatic species.

Methodology Consistent with Accepted Practice
Use of temperature loggers to gain information on thermal trends has been a standard technique to look at impacts of water storage associated with hydroelectric projects. We recommend that transects be established in the upper, middle, and lower project impoundment, as well as in the tailrace and downstream project. An additional transect should be established in the free flowing section of river above the impoundment to serve as a “reference site”. Inexpensive temperature loggers should be deployed along each transects at a minimum of three locations: at depths of 1 meter subsurface, mid-depth, and 1 meter off the bottom (on buoy lines) where water depths permit. The temperature loggers should be deployed from April 1 – November 15 and be set to record temperature at 15 minute intervals. The temperature loggers should be checked and the data downloaded on the monthly basis. The data from the loggers should then be used to develop hourly/daily aquatic isotherm maps, and temperature change and distribution as a result of project and cumulative impacts should be assessed.

Level of Effort/Cost, and Why Alternative Studies will not suffice
The effort and cost of this study is expected to be moderate to high, but the potential project specific and cumulative thermal alteration impacts have never been studied in a comprehensive manner and their potential impacts to aquatic habitat and fish, wildlife, and resources has not been adequately studied.

Literature Cited

Diana, J.S. 2004. Biology and Ecology of Fishes. 2nd edition. Biological Sciences Press.

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Study Request 23: Project Effects on Populations of Tessellated Darter, *Etheostoma olmstedi* (Docket Number p-1904) (Docket Number p-1855) (Docket Number p-1892)

Goals and Objectives

The goal of this study is to evaluate the effects of project operations on populations of tessellated darter (*Etheostoma olmstedi*), a New Hampshire species of greatest conservation concern and known host species for the federally-endangered dwarf wedgemussel (*Alasmidonta heterodon*). The specific objectives of the study are to:

Objective 1: Determine the distribution and abundance of tessellated darter within project-affected areas; and

Objective 2: Determine the effects of project operations on the distribution and abundance of tessellated darter.

Relevant Resource Management Goals and Public Interest Considerations

The tessellated darter is one of only three fish species in the Upper Connecticut River that serve as hosts for the glochidia of the federally-endangered dwarf wedgemussel, the others being the slimy sculpin (*Cottus cognatus*) and the Atlantic salmon (*Salmo salar*) (Wicklow 2005). Tessellated darters may be the most important hosts for the dwarf wedgemussel in the Upper Connecticut for the following reasons:

- The USFWS has decided to end its program of stocking hatchery-reared salmon in the Connecticut River basin and accordingly it is unlikely that salmon parr will be available as potential hosts.
- The tessellated darter appears to be more widespread than the slimy sculpin in the Bellow Falls and Wilder project areas where the dwarf wedgemussel is known to exist. Yoder et. al. (2009) found the darter in the project areas upstream and downstream of both dams, while the sculpin was not found in either project area.

It is the goal of the USFWS to recover the dwarf wedgemussel so that it can be removed from the Endangered Species list in the future. Populations in the Upper Connecticut River are dependent on healthy tessellated darter populations, and therefore a better understanding of how dam operations affect the darter is crucial to the recovery of the dwarf wedgemussel.

A mission of both the New Hampshire Fish and Game Department (NHFGD) and the Vermont Fish and Wildlife Department is to protect and conserve fish and wildlife and their habitats. Riverine fish species are an important component of the river’s ecology. Tessellated darter is identified by New Hampshire as a Species of Greatest Concern.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq*.), the Federal Power Act (16 U.S.C. §791a, *et seq*.), and the Clean Water Act (33 U.S.C. §1251 *et seq*.).

Existing Information and Need for Additional Information

In the Preliminary Application Documents (PADs) for the Wilder, Bellows Falls, and Vernon projects, the applicant acknowledges that tessellated darter is one of the confirmed hosts of dwarf wedgemussel. It also identifies the occurrence of tessellated darter both upstream and downstream of each project. However, studies that specifically target small-bodied benthic species are lacking in project-affected areas. It is therefore likely that results of previous investigations are biased and underestimate true population size. An effective evaluation of project effects on a population will require robust, unbiased estimates of population parameters such as abundance or occupancy and similar estimates of population parameters under known conditions of low to no effect.

Existing literature indicates that tessellated darters may be found in a variety of habitats (Scott and Crossman 1979, Van Snik Gray and Stauffer 1999, Hartel 2002, Van Snik Gray et al. 2005, Henry and Grossman 2008), but these habitats are not necessarily equal in their ability to support the population or its function as host to dwarf wedgemussel. We cannot be certain that habitat use infers preference, nor that habitat use will be consistent from basin to basin. Therefore, habitat use within project-affected areas should be evaluated, and should be evaluated in concert with population parameters. By estimating population parameters (e.g., abundance, occupancy, extinction/colonization) as functions of habitat, we may determine whether habitat contributes to any differences in populations and if so, what specific habitat is preferred for stable and persistent populations.

Project Nexus

Operations at the Wilder, Bellows Falls, and Vernon projects alter natural river flow and consequently cause changes in the availability of instream habitat on which the tessellated darter and other lotic species depend. Habitat for tessellated darters is directly related to project operations in terms of flow (water depth and velocity, and their timing, duration, frequency, and rate of change) as well as the interactions of flow with other habitat variables such as substrata, vegetation, and cover. Operations both upstream (changes to the reservoir) and downstream (changes to the flow regime) may affect habitat, and may consequently lead to changes in the distribution, abundance, and behavior of tessellated darters that could in turn potentially affect the federally-endangered dwarf wedge mussel, for which the tessellated darter is a host species.

The information collected for this requested study will help determine whether project operations have a substantial effect on populations of tessellated darter, or whether population parameters are consistent with those of other populations in the region. If there is an effect of project operations on darter populations, study results will also permit identification of those habitat components related to operations that are most important for maintenance of stable and persistent populations of tessellated darter. This will in turn provide information that will assist the development of recommendations aimed to maintain populations of dwarf wedgemussel.

Proposed Methodology

Using an accepted and robust field sampling design (e.g., as described in Pollock et al. 2002 or MacKenzie et al. 2006) and accepted methods for collecting tessellated darters and other similar small-bodied fishes, conduct a field survey for tessellated darters within all project-affected areas from the headwaters of the Wilder pool downstream to the Vernon dam, as well as in selected areas outside of the project-affected areas with known stable populations of tessellated darter and/or dwarf wedgemussel. Such a sampling design should include replicate samples for estimation of species detection probability. For each replicate sample, collect and record data that may be important for describing differences in populations of tessellated darter, such as presence or abundance of other species (e.g., dwarf wedgemussel, slimy sculpin *Cottus cognatus*), depth, velocity, water temperature, substrata, time of day, presence of cover, proportion of vegetation cover, size of individuals collected (juveniles may select different habitat; larger individuals may outcompete smaller individuals for preferred habitat), and other factors as determined by a qualified biologist. Include also as covariates any relevant flow characteristics (Zimmerman 2006) that may differ among sites.

Using methods as described by Kery et al. (2005), MacKenzie et al. (2006), or Wenger and Freeman (2008), determine whether population estimates of tessellated darter are different in project-affected areas and, if so, which measured factors or flow characteristics are most important in describing these differences.

Level of Effort and Cost

The cost for collecting the data for this study is entirely dependent on the number of sites, number of sample replicates, and the extent of the covariate data that are measured, all of which and should be determined during the development of the study plan in consultation with fishery agencies and other parties, and may be adjusted during the course of field sampling. In general, if a species is common and easily captured, few replicates and many sites produce the best estimates, whereas more replicates and fewer sites are preferable for rare species. In general, the more replicates added, the lower the errors in detection probability, and the more sites sampled, the lower the errors in population parameters. The number of people required in the field will be dependent on the sampling method that is selected, but should be at least two individuals. Provided the collected data are of high quality, analysis and synthesis should take at most 5-10 days.

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Study Request 24: Upstream American Eel Passage Assessment at Vernon, Bellows Falls and Wilder Projects (Docket Number p-1904) (Docket Number p-1855) (Docket Number p-1892)

Goals and Objectives

This study has two objectives:

1. Conduct systematic surveys of eel presence/abundance at tailrace and spillway locations at the Vernon, Bellows Falls, and Wilder projects to identify areas of concentration of eels staging in pools or attempting to ascend wetted structures that would potentially establish the most effective locations to place upstream eel passage facilities.
2. Collect eels with temporary trap/pass devices from areas identified from surveys as potential locations of eel concentration to assess whether eels can be collected/passed in substantial numbers, and whether locations are viable sites for permanent eel trap/pass structures.

Resource Management Goals

The Atlantic States Marine Fisheries Commission has developed two documents related to the management of American eel:

1 Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.
2 Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

In addition, the Connecticut River Atlantic Salmon Commission (CRASC) developed the draft document: A Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin in 2005. The goal of the plan is "to protect and enhance the abundance of the American eel resource to ensure its continued role in the Connecticut River Basin ecosystem…" Management objectives in the plan include the following:

1 Protect and enhance eel populations where they currently exist;
2 Where practical, restore populations to waters where they had historical abundance;
3 Provide effective upstream and downstream fish passage around dams and other barriers within the species' range in the basin; and
4 Comply with all requirements of the Fishery Management Plan of the ASMFC.

Based on these plans, the New Hampshire Fish and Game Department (NHFGD) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the three projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to upstream passage of American eel, the NHFGD's goals are:

1. Minimize current and potential negative project operation effects that could hinder management goals and objectives.
2. Minimize project-related sources of upstream passage delay, injury, and stress in order to facilitate access to historical rearing habitat.

The American eel (*Anguilla rostrata*), is also one of New Hampshire and Vermont's Species of Greatest Conservation Need (SGCN). The status for conservation need in Vermont is listed as high priority (Kart et al. 2005), and the species is listed as "vulnerable" in New Hampshire. As identified in Vermont's Wildlife Action Plan (Kart et al. 2005), threats to the species include the construction of large dams on rivers which obstruct juvenile fish access to critical rearing habitats, as well as mortality associated with passing through hydroelectric facilities' turbines during their outmigration to sea.

As outlined in Vermont's Wildlife Action Plan (Kart et al. 2005), research and monitoring needs for this SGCN include determining their distribution and abundance, as the contribution of eels in northern regions to overall stock is unknown. One of the conservation strategies for this species is to support efforts to enhance access of American eels to Vermont waters by eliminating or minimizing impacts of dams and other obstructions along the Richelieu, St. Lawrence, and Connecticut Rivers.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq*.), the Federal Power Act (16 U.S.C. §791a, *et seq*.), and the Clean Water Act (33 U.S.C. §1251 *et seq*.).

Public Interest

The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

Existing Information

The PAD contains no information relative to areas where eels seeking to move upstream concentrate downstream of the three dams, or annual numbers of eels attempting to ascend past the dams. While eels have been known to ascend the Vernon and Bellows Falls fish ladders, their efficiency for passing eels is unknown, and they are only operated during the American shad passage season (from April 15 through July 15). Eels are currently able to pass Vernon, Bellows Falls, and Wilder dams (as evidenced by documented presence of eels upstream), but the total number of eels attempting to pass all three dams and the proportion successfully passing each project is unknown (but suspected to be low). The downstream Holyoke Project has operated upstream eel passage facilities since 2004. Last year these facilities passed over 40,000 juvenile eels. While the next dam upstream (the Turners Falls Project; FERC No. 1889) has no dedicated upstream eel passage facilities, eels have been known to ascend the Cabot Station fish ladder (A. Haro, U.S. Geological Survey, pers. comm.). Although there is rearing habitat in between the Turners Falls and Vernon dams, some eels will attempt to continue upstream, and passage needs to be provided so these fish can access historical habitat.

These information gaps need to be filled so resource agencies can determine the best locations to site upstream eel passage facilities and assess whether operating the existing anadromous ladders would be an effective mechanism to move juvenile eels upstream past the projects.

We also note that within the past seven years, the United States Fish and Wildlife Service (USFWS) has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005 the USFWS issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability. On September 29, 2011 the USFWS issued a substantial 90-day finding and initiated a 12-month status review. It is our understanding that the USFWS is still accepting new American eel information for the ongoing status review.

Nexus to Project Operations and Effects

The three projects generate hydropower on the head created by the Vernon, Bellows Falls, and Wilder dams. These dams create barriers to upstream migrating eels. While some eels are able to pass dams, some are not, and the passability of a given dam depends on factors such as its height, hydraulics, presence of climbable surfaces, presence of predators, risk of exposure to heat or drying while climbing a dam, etc. All three dams are high (Vernon: 58 ft. high; Bellows Falls: 30 ft. high; and Wilder: 60 ft. high), and the majority of the dam faces are dry during most of the upstream eel passage season. Design of the dams is not currently amenable to passage of eels by climbing. As mentioned earlier, the existing anadromous passage facilities are not designed to pass eels, and even if some eels are able to ascend the ladders, they may incur delays (in attraction or passage rates), be size-selective (e.g. velocity barrier for small eels presented by ~8 ft/sec flow through weirs and orifices), present a potential predation risk (predators in or near the fishways), and are not operated throughout the upstream eel passage season.

Methodology Consistent with Accepted Practice

1. Objective 1: Systematic Surveys
   Surveys of eel presence and relative abundance should be conducted at regular intervals throughout the eel upstream migratory season (~1 May to ~15 October, or when river temperatures exceed 10 C). Surveys should consist of visual inspection and trapping in likely areas where eels may concentrate as they attempt to climb structures wetted by significant spill or leakage flow below the dams and associated structures. These locations include: the upstream fish ladders at all three projects (dewatered state) and leakage or overflow points along the downstream faces of all three dams, including spillways. Methods should include visual surveys (on foot, from a boat, or snorkeling) and trapping using small mesh (< 1/8" clear opening) baited eel pots. Visual surveys should be performed once per week, at night, preferentially during precipitation events. Trap sets should be performed once per week, with an overnight soak time. Recorded data should include location, observation of eels (presence, absence, relative numbers, relative sizes, behaviors, time/date of observation), and survey method.

2. Objective 2: Trap/Pass Collections
   Areas identified from Systematic Surveys as having significant number of eels present should be targeted as potential areas for permanent eel trap/passes, and should be initially assessed using temporary/portable trap passes. At a minimum (regardless of survey results), temporary trap passes should be installed at stilling basins and/or lower sections of fishways supplied with minimal attraction flow (0.5-1.0 cfs) during dewatered conditions at all three projects , as these locations may be supplemented with additional attraction flow and have high potential for being concentration points for upstream migrant eels. Similarly, traps should also be placed at spillway or bypass channel locations where eels have a potential to climb wetted (e.g., via leakage) flow zones, at the highest points where eels are able to climb to, or where otherwise feasible. Temporary trap/passes should be purpose-designed and built for each location, and operated throughout the eel upstream migratory season (~1May to 15 October, or when river temperatures exceed 10° C). Ramp-type traps with supplementary attraction flow are preferred temporary trap/pass designs. Traps should operate daily, with catches quantified every 2-3 days. Recorded data should include location, trapping interval, absolute numbers of eels trapped, relative eel sizes, and hydraulic and environmental conditions during the trapping period.

All collected eels from surveys should be released at their point of capture; those eels collected from trap/pass collections should be transported to and released into the headponds upstream of where they were collected.

These methodologies are consistent with accepted practice.

Level of Effort/Cost, and Why Alternative Studies will not suffice

The level of cost and effort for the survey component of the study would be low for each individual project (moderate for all three projects combined); a minimal number of personnel may be able to conduct the weekly surveys. The trap/pass component would require low to moderate cost and effort.

The NHFGD is not aware of any previously conducted or ongoing studies related to upstream eel passage. The applicant did not propose any studies to meet this need in the PAD.

Literature Cited

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department. Waterbury, Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm. (Accessed September 10, 2012).

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 25a: Wilder Hydroelectric Project: Water quality monitoring within the project impoundment and tailrace (Docket Number p-1892)

1. ***Goal and Objective***

   The goal of this study is to determine if the operational impacts of the Wilder Hydroelectric Project are causing or contributing to violations of New Hampshire and/or Vermont state water quality standards.

   The objective of this study will be to collect water temperature, dissolved oxygen, specific conductance, pH, nutrients, and chlorophyll-a data at multiple locations in the project area. This monitoring effort will consist of both instantaneous measurements and continuous data collected via multi-parameter dataloggers. Data should be collected under normal operating conditions and ambient conditions that include periods of low flow and higher water temperatures. Weekly profiles and grab samples should reflect various flow conditions. The water quality data will be compared to both Vermont and New Hampshire water quality standards to determine if the project is causing or contributing to water quality standard violations.

2. ***Resource Management Goals***

   The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Vermont lists the section of the Connecticut River below the Wilder dam on the Section 303(d) impaired water list due to flow alterations aquatic life and habitat.

   All sections of the Connecticut River related to the project are classified by New Hampshire as Class B. It should be noted that although the classification name is the same as Vermont's, New Hampshire surface water criteria for Class B waters, are in some cases, different from Vermont's.

   New Hampshire surface water quality standards (Env-Wq 1703.01) state that the surface water quality criteria for all surface waters shall be restored to meet the water quality criteria for their designated classification, including existing and designated uses, and to maintain the chemical, physical, and biological integrity of surface water.

   A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD’s 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1 New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2 New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3 New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4 Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq*.), the Federal Power Act (16 U.S.C. §791a, *et seq*.), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

3. Public Interest Consideration

The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

4. Existing Information

The PAD contains information on water quality monitoring that was completed between June 20, 2012 and September 11, 2012 in the tailrace and just upstream of the dam. The data indicated that Vermont Water Quality Standards for dissolved oxygen were not met during a seven day period in August. The PAD does not provide information on the water quality throughout the impoundment or how water quality is affected by project operations. The PAD does indicate that in general temperature, specific conductance, and pH did increase from upstream to downstream while dissolved oxygen decreased, reflecting the impacts of the impoundment.

5. Project Nexus

The project impounds 45 miles of river that would otherwise be free flowing. It currently operates in a peaking mode, with allowable impoundment fluctuations of up to 5 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (675 cfs). Water quality can be affected by the operating mode of a hydropower project. The PAD provides limited information on how project operations affect water quality within the project impoundment and tailrace.

Operations of the project must conform to Vermont and New Hampshire water quality standards. The NHFGD requests a study that will provide the data needed to determine if the Connecticut River in the vicinity of the Wilder Hydroelectric Project is or is not attaining the water quality standards of both states.

6. ***Proposed Methodology***

The methodology for this study should be similar to TransCanada's water quality monitoring in 2012 including weekly vertical profiles within the impoundment, weekly water quality samples of nutrients and chlorophyll-a for laboratory analysis and the deployment of multi-parameter continuous dataloggers at multiple locations within the impoundment and tailrace. An additional site should be monitored in the free flowing section of the river above the impoundment to serve as a "reference site". At each designated datalogger monitoring location at least 10 days of data should be collected at 15 minute increments during a period of low flow ($\leq$3 x 7Q10) and high temperatures (preferably over 23 degrees C) between June 1 and September 30. Dataloggers deployed in the impoundment should be set at the bottom of the epilimnion (if stratified) or at 25% depth if not stratified. A vertical dissolved oxygen and water temperature profile should be conducted at the time of deployment of dataloggers in the impounded section to determine if river is stratified and thus the appropriate depth for deployment. Water quality results should be graphically compared to both state water quality standards and project operations, including the generation status, impoundment elevation, and discharge.

If low flow conditions are not met the first year of the study, a second year of data may be necessary.

It is preferable that the water quality monitoring for all three projects be coordinated so that sampling can occur at each location within each project during the same period of time and under the same operational, flow, and environmental conditions.

7. ***Level of Effort and Cost***

The cost and effort of this study will be moderate, but is important to document the potential impact operations have on water quality and determine if they meet Vermont and New Hampshire water quality standards.

Literature Cited:

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 25b: Bellow Falls Hydroelectric Project: Water quality monitoring within the project impoundment, bypass, and tailrace (Docket Number p-1855)

1. ***Goal and Objective***

   The goal of this study is to determine if the operational impacts of the Bellows Falls Hydroelectric Project are causing or contributing to violations of New Hampshire and/or Vermont state water quality standards.

   The objective of this study will be to collect water temperature, dissolved oxygen, specific conductance, pH, nutrients, and chlorophyll-a data at multiple locations in the project area. This monitoring effort will consist of both instantaneous measurements and continuous data collected via multi-parameter dataloggers. Data should be collected under normal operating conditions and ambient conditions that include periods of low flow and higher water temperatures. Weekly profiles and grab samples should reflect various flow conditions. The water quality data will be compared to both Vermont and New Hampshire water quality standards to determine if the project is causing or contributing to water quality standard violations.

2. ***Resource Management Goals***

   The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Vermont list the section of the Connecticut River above and below Bellows Falls dam on the Section 303(d) impaired water list due to flow alterations impairing aquatic life and habitat.

   All sections of the Connecticut River related to the project are classified by New Hampshire as Class B. It should be noted that although the classification name is the same as Vermont's, New Hampshire surface water criteria for Class B waters, are in some cases, different from Vermont's.

   New Hampshire surface water quality standards (Env-Wq 1703.01) state that the surface water quality criteria for all surface waters shall be restored to meet the water quality criteria for their designated classification, including existing and designated uses, and to maintain the chemical, physical, and biological integrity of surface water.

   A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1) New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2) New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3) New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq*.), the Federal Power Act (16 U.S.C. §791a, *et seq*.), and the Clean Water Act (33 U.S.C. §1251 *et seq.*).

3. ***Public Interest Consideration***
The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

4. ***Existing Information***
The PAD contains information on water quality monitoring that was completed between June 20, 2012 and September 12, 2012 in the tailrace, bypass reach and just upstream of the dam. Additionally, weekly water column profiles were collected at three locations within the impoundment. The data indicated that Vermont and New Hampshire water quality standards for dissolved oxygen were not met in the bypass reach and in the impoundment. Furthermore, pH readings collected in water profile measurements indicated that in two different locations during two separate events in the impoundment did not meet Vermont and New Hampshire water quality standards. The PAD does not provide information on the continuous water quality throughout the impoundment or how water quality is affected by project operations. The PAD indicates that in general temperature, specific conductance, and pH did increase from upstream to downstream while dissolved oxygen decreased, reflecting the impacts of the impoundment.

5. ***Project Nexus***
The project impounds 26 miles of river that would otherwise be free flowing. It currently operates in a peaking mode, with allowable impoundment fluctuations of up to 3 feet,

with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1083 cfs). Water quality can be affected by the operating mode of a hydropower project. The PAD provides limited information on how project operations affect water quality within the project impoundment, bypass reach and tailrace.

Operations of the project must conform to Vermont and New Hampshire water quality standards. The NHFGD requests a study that will provide the data needed to determine if the Connecticut River in the vicinity of the Wilder Hydroelectric Project is or is not attaining the water quality standards of both states.

6. ***Proposed Methodology***

The methodology for this study should be similar to TransCanada's water quality monitoring in 2012 including weekly vertical profiles within the impoundment, weekly water quality samples of nutrients and chlorophyll-a for laboratory analysis and the deployment of multi-parameter continuous dataloggers at multiple locations within the impoundment, the bypass reach, and tailrace. An additional site should be monitored in the 17 mile free flowing section of the river above the impoundment to serve as a "reference site". At each designated datalogger monitoring location at least 10 days of data should be collected at 15 minute increments during a period of low flow ($\leq$3 x 7Q10) and high temperatures (preferably over 23 degrees C) between June 1 and September 30. Dataloggers deployed in the impoundment should be set at the bottom of the epilimnion (if stratified) or at 25% depth if not stratified. A vertical dissolved oxygen and water temperature profile should be conducted at the time of deployment of dataloggers in the impounded section to determine if river is stratified and thus the appropriate depth for deployment. Water quality results should be graphically compared to both state water quality standards and project operations, including the generation status, impoundment elevation, and discharge.

If low flow conditions are not met the first year of the study, a second year of data may be necessary.

It is preferable that the water quality monitoring for all three projects be coordinated so that sampling can occur at each location within each project during the same period of time and under the same operational, flow, and environmental conditions.

7. ***Level of Effort and Cost***

The cost and effort of this study will be moderate, but is important to document the potential impact operations have on water quality and determine if they meet Vermont and New Hampshire water quality standards.

Literature Cited:

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 25c: Vernon Hydroelectric Project: Water quality monitoring within the project impoundment and tailrace (Docket Number p-1904)

1. ***Goal and Objective***

   The goal of this study is to determine if the operational impacts of at the Vernon Hydroelectric Project are causing or contributing to violations of New Hampshire and/or Vermont state water quality standards.

   The objective of this study will be to collect water temperature, dissolved oxygen, specific conductance, pH, nutrients, and chlorophyll-a data at multiple locations in the project area. This monitoring effort will consist of both instantaneous measurements and continuous data collected via multi-parameter dataloggers. Data should be collected under normal operating conditions and ambient conditions that include periods of low flow and higher water temperatures. Weekly profiles and grab samples should reflect various flow conditions. The water quality data will be compared to both Vermont and New Hampshire water quality standards to determine if the project is causing or contributing to water quality standard violations.

2. ***Resource Management Goals***

   The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Vermont lists the section of the Connecticut River above and below Vernon dam on the Section 303(d) impaired water list due to flow alterations impairing aquatic life and habitat.

   All sections of the Connecticut River related to the project are classified by New Hampshire as Class B. It should be noted that although the classification name is the same as Vermont's, New Hampshire surface water criteria for Class B waters, are in some cases, different from Vermont's.

   New Hampshire surface water quality standards (Env-Wq 1703.01) state that the surface water quality criteria for all surface waters shall be restored to meet the water quality criteria for their designated classification, including existing and designated uses, and to maintain the chemical, physical, and biological integrity of surface water.

   A mission of the New Hampshire Fish and Game Department (NHFGD) relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1) New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2) New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3) New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq*.), the Federal Power Act (16 U.S.C. §791a, *et seq*.), and the Clean Water Act (33 U.S.C. §1251 *et seq*.).

3. ***Public Interest Consideration***
The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

4. ***Existing Information***
The PAD contains information on water quality monitoring that was completed between June 20, 2012 and September 11, 2012 in the tailrace and just upstream of the dam. Temperature data indicated that it reached levels that would be critical threshold for salmonids, and above the natural regime for the river. The PAD does not provide information on the water quality throughout the impoundment or how water quality is affected by project operations. The PAD does indicates that in general temperature, specific conductance, and pH did increase from upstream to downstream while dissolved oxygen decreased, reflecting the impacts of the impoundment on increase travel time in the river.

5. ***Project Nexus***
The project impounds 26 miles of river that would otherwise be natural free-flowing. It currently operates in a peaking mode, with allowable impoundment fluctuations of up to 8 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1250 cfs). Water quality can be affected by the operating mode of a hydropower project. The PAD provides limited information on how project operations affect water quality within the project impoundment and tailrace.

Operations of the project must conform to Vermont and New Hampshire water quality standards . The NHFGD requests a study that will provide the data needed to determine if the Connecticut River in the vicinity of the Wilder Hydroelectric Project is or is not attaining the water quality standards of both states.

6. ***Proposed Methodology***

The methodology for this study should be similar to TransCanada's water quality monitoring in 2012 including weekly vertical profiles within the impoundment, weekly water quality samples of nutrients and chlorophyll-a for laboratory analysis and the deployment of multi-parameter continuous dataloggers at multiple locations within the impoundment and tailrace. An additional site should be monitored in the free flowing section of the river above the impoundment to serve as a "reference site". At each designated datalogger monitoring location at least 10 days of data should be collected at 15 minute increments during a period of low flow ($\leq$3 x 7Q10) and high temperatures (preferably over 23 degrees C) between June 1 and September 30. Dataloggers deployed in the impoundment should be set at the bottom of the epilimnion (if stratified) or at 25% depth if not stratified. A vertical dissolved oxygen and water temperature profile should be conducted at the time of deployment of dataloggers in the impounded section to determine if river is stratified and thus the appropriate depth for deployment. Water quality results should be graphically compared to both state water quality standards and project operations, including the generation status, impoundment elevation, and discharge.

If low flow conditions are not met the first year of the study, a second year of data may be necessary.

It is preferable that the water quality monitoring for all three projects be coordinated so that sampling can occur at each location within each project during the same period of time and under the same operational, flow, and environmental conditions.

7. ***Level of Effort and Cost***

The cost and effort of this study will be moderate, but is important to document the potential impact project operations have on water quality and determine if they meet Vermont and New Hampshire water quality standards.

Literature Cited:

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Study Request 26: Impact of Vernon Project Operations on Downstream Migration of Juvenile American Shad (Docket Number p-1904)

Conduct a field study of juvenile American shad outmigration at the Vernon Dam to determine if project operations negatively impact juvenile shad survival and production.

Goals and Objectives

Determine if project operations affect juvenile American shad outmigration survival, recruitment, and production. The following objectives will address this request:

- Assess project operation effects of Vernon Dam on the timing, routes, migration rates, and survival of juvenile shad;
- Determine the proportion of juvenile shad that as a downstream passage route choose or are directed to existing downstream bypass structures, gate structures, or are entrained into the station turbines and assess delay, survival, timing, and related impacts with these locations under a full range of operational conditions, over the period of outmigration;
- Determine survival rates for juvenile shad entrained into Vernon Station units.

If it is determined that the project operations or related effects are adversely affecting juvenile shad survival, migration timing, or other deleterious population effects are noted, identify operational solutions or other solutions that will reduce and minimize impacts, within the project affected area. This study will require two years of field data to capture inter-annual variability of river discharge, water temperature, and variability in run size and juvenile production (and timing of developmental stages) and variability in outmigration timing which may relate to spring, summer and fall conditions.

Resource Management Goals

The Connecticut River Atlantic Salmon Commission developed *A Management Plan for American Shad in the Connecticut River* in 1992. Management Objectives in the plan include the following:

1. Achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually.

2. Maximize outmigrant survival for juvenile and spent adult shad.

The Atlantic States Marine Fisheries Commission Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management), approved in 2010 includes the following objective:

1. Maximize the number of juvenile recruits emigrating from freshwater stock complexes.

The New Hampshire Fish and Game Department (NHFGD) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1) Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.

2) Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to American shad, the NHFGD's goals are:

1. Minimize current and potential negative project operation effects on juvenile American shad survival, production, and recruitment.

A mission of the NHFGD relevant to this study request is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

Four goals from the NHFGD's 1998-2010 Strategic Plan (NHFGD 1998) which are relevant to this study request are:

1) New Hampshire has a wide range of naturally occurring habitats and healthy, naturally functioning ecosystems.
2) New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3) New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.
4) Human activities and land uses are compatible with desired population and recreational goals for fish, wildlife, and marine species and the ecosystems that sustain them.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *e seq*.), the Federal Power Act (16 U.S.C. §791a, *et seq*.), and the Clean Water Act (33 U.S.C. §1251 *et seq*.).

Public Interest

The New Hampshire Fish and Game Department is requesting this study. The requestor is a state natural resource agency.

Existing Information

Adult shad are counted annually as they pass the Vernon Dam. Juvenile American shad production has been monitored upstream of the Vernon Dam and immediately downstream of that dam by Vermont Yankee Nuclear as part of an annual monitoring program using both boat electrofishing (since 1991) and beach seining (since 2000). A seasonal average annual index of juvenile American shad standing crop in Vernon reservoir has been calculated since 2000. Estimates of juvenile shad growth rates in the Vernon impoundment have been calculated annually beginning in 2004, and also in a study conducted in 1995 (Smith and Downey 1995).

Although there were numerous studies of downstream passage facilities at the Vernon Project for Atlantic salmon smolts, passage studies for American shad were limited to tests in 1991 and

1992 of a high frequency sound field to guide fish to the fish pipe, the primary downstream fishway (RMC 1993). Although the studies were deemed incomplete, the technology indicated some level of response by juvenile shad. However, despite that conclusion, there is no indication that this technology or other downstream passage studies with juvenile shad were subsequently pursued.

Nexus to Project Operations and Effects

Juvenile American shad production occurs in the river reach between the Vernon Dam and the Bellows Falls Dam, which is thought to be the historic upstream limit of the shad migration in the Connecticut River. Juvenile American shad require safe and timely downstream passage measures to have the opportunity to contribute to the restoration target population size.

There is little information available regarding the total impact of the Vernon project on downstream migration of juvenile shad. Migration delays, increased predation, mortality during passage over the dam or through turbines, and changes in route selection under different flow conditions are potential influences of the Vernon Dam on the juvenile shad population in the upper Connecticut River. Effective upstream and downstream passage and successful in-river spawning and juvenile production are necessary to help achieve shad management restoration goals for the Connecticut River, particularly in the upstream reaches. Delays in juvenile American shad outmigration may affect survival rates in the transition to the marine environment (Zydlewski et al. 2003).

Methodology Consistent with Accepted Practice

The impact to juvenile shad outmigrants would be best studied by a combination of approaches including hydroacoustics, radio telemetry (including passive integrated transponder (PIT) telemetry), and turbine balloon tags. Project discharge adjustments at the dam should be examined relative to timing, duration, and magnitude of juvenile shad migration to and through the dam, with hydroacoustic equipment for natural/wild fish information. In addition, study fish should be collected and tagged (PIT, radio, balloon) to then empirically determine rates of survival for fish passed through the project under varied operations, from minimum flows up to full spill conditions. The release of tagged fish (radio, PIT) at a number of potential sites will provide data on delay and route selection as juvenile shad move through the Vernon project area. The number and location of release sites will depend on the availability of tagged fish.

Additional hydroacoustic assessment immediately upstream and downstream of the Vernon Dam will provide information on the timing of migration to and through this area. A more focused survival study, using balloon tags, PIT tags, or other appropriate methods, should be conducted in the second year based upon the first year of study findings relative to the frequency, magnitude, timing, and route selection of juvenile American shad through the Vernon project.

Level of Effort/Cost, and Why Alternative Studies will not suffice

TransCanada does not propose any studies to meet this need. Estimated cost for the study is expected to be high with the majority of costs associated with equipment (hydroacoustic gear, radio tags, radio receivers, and PIT readers) and related fieldwork labor.

Literature Cited:

NHFGD 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

RMC Environmental Services, Inc. 1993. Effect of ensonification on juvenile American shad movement and behavior at Vernon Hydroelectric Station, 1992 – Draft Report, March 1993.

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Zydlewski, J., S. D. McCormick, and J. G. Kunkel. 2003. Late migration and seawater entry is physiological disadvantageous for American shad juveniles. Journal of Fish Biology #63, 1521-1537.

STATE OF NEW HAMPSHIRE
DEPARTMENT of RESOURCES and ECONOMIC DEVELOPMENT
DIVISION of FORESTS and LANDS
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27 February 2013

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E., Room 1A
Washington, DC 20426

RE: Comments on October 2012 Pre-Application Documents (PADs) and December 2012 Scoping Document 1 (SD1)
Wilder Hydroelectric Project (Project No. 1892-026)
Bellows Falls Hydroelectric Project (Project No. 1855-045)
Vernon Hydroelectric Project (Project No. 1904-073)
TransCanada Hydro Northeast, Inc.

Dear Secretary Bose:

The New Hampshire Natural Heritage Bureau (NHB), in the NH Department of Resources and Economic Development (DRED), is pleased to provide the following comments on the October 2012 Pre-Application Documents (PADs) prepared by TransCanada Hydro Northeast, Inc. for three dam relicensing projects on the Connecticut River: Wilder Hydroelectric Project (Project No. 1892-026), Bellows Falls Hydroelectric Project (Project No. 1855-045), and Vernon Hydroelectric Project (Project No. 1904-073).

NHB Comments on PADs

1. Section 3.8.3 (Wilder, Bellows Falls, and Vernon PADs). Although the PADs describe the types of wetlands that occur in the project areas they do not address how project operations could affect wetland extent, type, and composition. NHB is submitting a study request (based on a similar request from Vermont) to assess potential wetland impacts (Appendix A).

2. Section 3.8.3 (Wilder, Bellows Falls, and Vernon PADs). The PADs state that floodplain forests are generally above the influence of daily water level fluctuations. However, project operations will have some effects on these important natural communities, including affecting the extent of nearby sources for invasive plant propagules. NHB is submitting a study request to assess project impacts to floodplain forests, particularly invasive plant abundance (Appendix B).

3. Section 3.9 (Wilder PAD). The RTE Project Area for rare, threatened, and endangered species (defined on pg. 3-106) does not include areas affected by dam releases downstream of Wilder Dam. NHB requests that the RTE Project Area be extended downstream from the dam to the next impoundment area, since fluctuations in water level due to project operation do occur in this area (which includes the three known populations of the federally listed Jesup's milk-vetch plant).

4. Section 3.9.4 (Wilder, Bellows Falls, and Vernon PADs). NHB acknowledges and appreciates the preliminary (2012) studies that TransCanada conducted to assess impacts to RTE plants and the federally listed Jesup's milk-vetch. However, drafts of the reports were not received by NHB until 25 February, 2013, too close to the March 1 deadline for PAD comments to allow review by NHB and other concerned agencies. We are therefore re-submitting the study requests at this time (Appendices C and D); requests that will be withdrawn if the studies done to date accomplish the requested objectives.

5. Section 3.9.4 (Wilder, Bellows Falls, and Vernon PADs). The PADs for all three projects state that "Many rare plant species populations have apparently adapted, tolerate, or rely on the existing flow regime with the particular zone they occur in" (e.g. Wilder PAD, pg. 3-112). This is a flawed statement. A more accurate description is in Section 3.7.4 of all three PADs, e.g. (for Wilder): "The average daily water level fluctuation of 2.5 vertical feet has resulted in a zone of sparse vegetation along most of the shorelines of the impoundment. Wetland- or water-dependent wildlife and plant species will most likely be adversely affected by the daily wetting and drying cycles along the river's edge."

6. Section 3.9.5 (Wilder, Bellows Falls, and Vernon PADs). The PADs for all three projects state that "Because no changes are proposed to project operations, no new effects on rare state, or federal terrestrial plant species or communities resources are anticipated" (e.g. Wilder PAD, pg. 3-113). However, NHB is concerned about ongoing effects to RTE species and exemplary natural communities.

NHB Comments on SD1

1. Section 4.2.5 (Threatened and Endangered Species) refers only to species listed under the federal Endangered Species Act (ESA). NHB requests that FERC takes into account impacts to state-listed plant species and exemplary natural communities per NH RSA 217-A, which identifies these elements as a priority for conservation in the state (e.g. 217-A:7 "To the extent possible actions funded or carried out by state agencies shall not jeopardize the continued existence of any protected plant species or exemplary natural community")

Thank you for the opportunity to comment. If you have any questions, please contact me at (603) 271-2214 (Sabrina.Stanwood@dred.state.nh.us).

Sincerely,

Sabrina Stanwood

Sabrina Stanwood
Administrator, Natural Heritage Bureau
Division of Forests & Lands - DRED

cc: Susi von Oettingen, USFWS
Bob Popp, VT Natural Heritage Inventory
John Ragonese, TransCanada

Appendix A

Study Request: Impacts of Water Level Fluctuation in Project Impoundments on Wetlands (Project Nos. 1892, 1855, and 1904)

Goals and Objectives
The goal of this study is to determine the impacts to wetlands from daily and seasonal water level fluctuation in the impoundments from the Wilder, Bellows Falls, and Vernon Hydroelectric Project operations.

The objectives of this study are to identify all wetlands types within the project boundaries and impoundments, and determine the proportion of wetlands and wetland type (i.e. emergent, shrub, forested) that are impacted by daily and seasonal water level fluctuations from project operations. Ratios of wetland types in the project area should be compared to previous national wetland inventory maps, and/or to reference conditions to determine if wetland types within the project impoundment are being altered by project operations. The objectives are also to determine how project operations are affecting the wetland plant community composition, including promoting the spread of invasive species or affecting rare, threaten, and endangered species.

Resource Management Goals
RSA 217: A (The Native Plant Protection Act) outlines specifically that the NH Natural Heritage Bureau (NHB) engage in investigation and research. 217-A: 4 "The department shall conduct investigations on all species of plants and natural communities indigenous to and throughout this state necessary to develop information relating to population, distribution, habitat needs, limiting factors, and other biological and ecological data, and to determine protective measures and requirements necessary for their survival."

RSA 482- Outlines the mission of the NH Department of Environmental Services Wetlands Bureau to protect and preserve submerged lands under tidal and freshwaters and its wetlands (both salt water and fresh-water) from unregulated alteration that would adversely affect the natural ability of wetlands to absorb flood waters, treat storm water and recharge groundwater supplies, impact fish and wildlife of significant value and depreciate or obstruct the commerce, recreation and the aesthetic enjoyment of the public.

Public Interest
Not applicable.

Existing Information
The PAD does not address how wetlands type or wetland community composition could be impacted by daily and seasonal water level fluctuations within the impoundment.

Project Nexus
The projects (FERC No. 1892, 1855, and 1904) currently operates in a peaking mode, with allowable impoundment fluctuations of up to 8 feet, with proposals to continue as such. Wetlands can be affected by the operations of the hydropower project depending on frequency, timing, amplitude and duration of impoundment fluctuations. The PAD provides limited information on how project operations affect wetlands and the plant community composition within the project impoundment. Operations of the project should conform to New Hampshire Department of Environmental Services' goal of protecting significant wetlands and their values and functions, while ensuring that there is no net loss of such wetlands. The Natural Heritage Bureau requests a study to determine the impact by normal daily and seasonal operations of the project on wetland communities.

Proposed Methodology

The widely accepted methodology in the Federal Manual for Identifying and Delineating Jurisdictional Wetlands, and supplemental guidance documents issued by the U.S. Army Corps of Engineers is recommended for identifying wetlands. The general community composition should be recorded as well as any rare, threaten or endangered plant species or invasive species. The proportion of wetlands that are impacted by project operations should be compared to reference wetlands communities to evaluate how plant species composition has been altered by project operations. The frequency, timing, amplitude, and duration of reservoir fluctuations on impacted wetlands should be recorded throughout the year. The ratio of wetland types presently identified in the project boundaries should be compared to national wetland inventory maps to address whether project operations have altered wetlands.

We also propose that data collection include the use of the NHB's Level 2 Ecological Integrity Assessment method (EIA). Characteristics of the NHB EIA include:

- Reliance on a general conceptual model that:
  - Identifies the major ecological attributes – landscape context, size, and the condition of vegetation, soils, and hydrology.
  - Provides a narrative description of declining integrity levels based on changes to ecological attributes.
  - Uses a metrics-based approach to assess the levels of integrity.
- Use of ecological classifications at multiple scales to guide the development of the conceptual models, thereby enhancing attribute assessment.
- A Level 1 remote sensing approach for assessing landscape context using GIS prior to a site visit.
- Ecosystem stressors measured to inform evaluation of condition metrics.
- Ratings and thresholds for each metric based on "normal' or "natural range of variation" benchmarks.
- A scorecard matrix for rating and integrating metrics into an overall set of indices of ecological integrity.

Level of Effort and Cost

The cost and effort of this study will be moderate, but is important to document the potential impact operations have on wetlands within the vicinity of the project to determine if New Hampshire's wetland management goals are being met.

Appendix B

Study Request: Establishment of Permanent Plots to Assess the Impacts of Ongoing Operations on Floodplain Forest Communities (Project Nos. 1892, 1855, and 1904)

Goals and Objectives

The goal of this study is to determine the ongoing impacts to floodplain forests along the Connecticut River from daily and seasonal water level fluctuations associated with hydroelectric project operations. Natural flood regimes help create and maintain floodplain forest communities. Hydroelectric operations alter natural flood regimes and daily flow. The establishment of permanent plots is the best method to capture long term trends and changes associated with ongoing operations.

The objective of this study is to establish permanent plots in floodplain forest communities to monitor long-term changes and trends in species composition and community structure. Data collected during the establishment of these permanent plots will serve as baseline for future data comparisons. Invasive species are a particular threat to floodplain forests, as these species thrive on disturbance, and affect native species composition including potential impacts to rare, threaten, and endangered species.

Resource Management Goals

RSA 217: A (The Native Plant Protection Act) outlines specifically that the NH Natural Heritage Bureau (NHB) engage in investigation and research. 217-A: 4 "The department shall conduct investigations on all species of plants and natural communities indigenous to and throughout this state necessary to develop information relating to population, distribution, habitat needs, limiting factors, and other biological and ecological data, and to determine protective measures and requirements necessary for their survival."

Public Interest

The general public has a growing interest in the spread and control of invasive species.

Existing Information

A 1998 Natural Heritage report, "Floodplain Forest Natural Communities Along Major Rivers in New Hampshire" (Bechtel and Sperduto 1998) inventoried and classified floodplain forest communities and includes some data on the Connecticut River floodplain forests. This report, along with known locations of exemplary floodplain forests in the NHB database can serve as background information for the proposed study plan.

Project Nexus

The PAD currently dismisses concerns for floodplain forests stating that they are situated at higher elevations that would not be impacted by daily operations. However, it is hard to ignore the fact that operations have altered natural flood regimes. Floodplain forests can be affected by the operations of the hydropower project depending on frequency, timing, amplitude and duration of impoundment fluctuations and as well as downstream fluctuations. The PAD provides limited information on how ongoing project operations affect floodplain forest communities.

Proposed Methodology
Establishment of permanent plots within floodplain forests communities should be 20m x 20m and follow standard NHB methodology for data collection. We also propose that data collection include the use of the NHB's Level 2 Ecological Integrity Assessment method (EIA).

Standard NHB data collection includes:

- Natural community system type (Sperduto 2011
- Natural community type (Sperduto and Nichols 2011)
- Identification of all native and non-native plant species
- Percent coverage estimates for all plant species
- Other descriptive notes including information on soils and other physical site characteristics, evidence of human disturbance, size of the community, and evidence of wildlife
- Diagnostic natural community and rare species photographs.

Characteristics of the NHB EIA include:

- Reliance on a general conceptual model that:
    - Identifies the major ecological attributes – landscape context, size, and the condition of vegetation, soils, and hydrology.
    - Provides a narrative description of declining integrity levels based on changes to ecological attributes.
    - Uses a metrics-based approach to assess the levels of integrity.
- Use of ecological classifications at multiple scales to guide the development of the conceptual models, thereby enhancing attribute assessment.
- A Level 1 remote sensing approach for assessing landscape context using GIS prior to a site visit.
- Ecosystem stressors measured to inform evaluation of condition metrics.
- Ratings and thresholds for each metric based on "normal' or "natural range of variation" benchmarks.
- A scorecard matrix for rating and integrating metrics into an overall set of indices of ecological integrity.

Level of Effort and Cost
The cost and effort of this study will be low to moderate because this particular study request only includes the establishment of permanent plots and one year's worth of baseline data.

Appendix C

Study Request: River Levels Relative to Jesup's Milk-Vetch Populations (Project No. 1892)

Goals and Objectives

The goal of the study is to assess the extent to which fluctuations in river level affect Jesup's milk-vetch (*Astragalus robbinsii* var. *jesupii*), a plant federally listed as Endangered. The only three known populations occur on rock outcrops at the edge of the Connecticut River below Wilder Dam. Part of the Recovery Plan for the taxon is the establishment of additional populations to reduce the risk of extinction due to stochastic events. One experimental population has been established along the same stretch of river.

The primary objective of the study is to determine the water levels (cfs at the West Lebanon gage) at which Jesup's milk-vetch (JMV) populations are partially or fully covered by water, at all three populations and one introduction site. To accomplish this, objectives include: determining the elevation of existing benchmarks (bolts drilled into the bedrock); establishing additional benchmarks where necessary, e.g. at the introduction site; and developing equations for predicting flow levels that would result in inundation of the plants.

Resource Management Goals

The Endangered Species Act requires federal agencies, in consultation with the U.S. Fish and Wildlife Service to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat of such species. Therefore one goal of the FERC relicensing process should be that project operations do not jeopardize JMV populations.

Public Interest Considerations

Not applicable.

Existing Information

All three JMV sites have been studied since the early 1990s, so extensive data are available on plant numbers and approximate locations within sites. However, the lowest water level that affects the plants is unknown. In 1998, permanent bolts were drilled into bedrock at all three sites at two elevations relative to an arbitrary reference point. Annual censuses since then have documented plant numbers relative to the permanent bolts. However, the elevation of the bolts relative to water levels at specific cfs values is unknown.

Project Nexus

High-water events are known to affect the JMV plants and their habitat through soil deposition, direct removal of plants in summer floods, and ice scour (all the plants grow below the woody vegetation line on rock outcrops). The range of river level fluctuations associated with daily project operations is unlikely to affect many existing plants, since most seem to grow slightly above typical release levels. However, releases at certain times of the year, including periodic high flows outside of the growing season, may be critical to maintaining suitable habitat. There may be cost-effective adjustments to river levels that could be provided by the project that would improve the long-term survival of the taxon.

Proposed Methodology
Steps toward achieving the objectives of the study will include surveying the elevation of existing bolts (benchmarks) and establishing new ones. Developing models to predict water levels relative to cfs values at the Lebanon gage at each of the JMV sites could be accomplished with data loggers and opportunistic or planned high water releases.

Effort and Cost
The level of effort and cost will depend in part on the methodology chosen to derive water level forecast models. The basic objective of documenting elevation of benchmarks relative to river levels should be achievable at relatively low cost, and the full objective of modeling inundation of JMV plants relative to releases should be achievable at low to moderate cost.

Appendix D

Study Request: River Levels Relative to RTE Plant Species and Exemplary Natural Communities (Project Nos. 1892, 1855, and 1904)

Goals and Objectives

The goal of the study is to assess the extent to which fluctuations in river level affect populations of state-Threatened and Endangered plants, rare plants (S1 and S2), and exemplary natural communities. The objectives include identifying the number of rare elements that are likely to be negatively impacted, and assessing their importance to the conservation goals of the state of NH.

Resource Management Goals

The NH Native Plant Protection Act of 1987 (RSA 217-A) states that "To the extent possible actions funded or carried out by state agencies shall not jeopardize the continued existence of any protected plant species or exemplary natural community." The NH Natural Heritage Bureau (NHB) requests that FERC recognize this state priority and consider project impacts to state-listed and exemplary natural communities.

Public Interest Considerations

Not applicable

Existing Information

A total of 149 rare plant populations and 10 exemplary natural communities are mapped in the NHB database as occurring at the edge of the Connecticut River within the area affected by the three lower Connecticut River dams (FERC Project Nos. 1892-026, 1855-045, and 1904-073). The plants occur mostly in clusters within particularly significant habitats (e.g. islands and riverside seeps). The majority (65%) have not been surveyed within the last 10 years, so their current condition is unknown. In addition, several other rare plant populations and exemplary natural communities are predicted to occur along stretches of the river that have not been surveyed specifically for these elements.

Project Nexus

River level fluctuations due to project operations have significant effects on plant populations and natural communities along the river's edge through a combination of erosion and frequent cycles of wetting and drying.

Proposed Methodology

We are requesting surveys of river stretches that experience significant fluctuations in water level during power generation, to determine what state-rare species and exemplary natural communities are likely to be affected and to assess their current condition. The NHB database will provide a means of assessing the significance of any impacts by determining how the condition of occurrences along the CT River bank compares to that of occurrences elsewhere in the state, and what proportion they represent of all known NH occurrences.

Target elements: Riparian and wetland plant species and natural community types identified as occurring in the impact area based on a GIS analysis by the NH and VT Natural Heritage programs.

Geographic extent: The study should cover areas not only below the dams but also along the banks of the reservoirs. River banks and aquatic bed habitats would be the primary areas of interest. In areas where state-rare natural community types occur adjacent to the river the study might extend further landward.

Survey methods: The approach would be to conduct a water-based survey during summer (low water levels). Each bank of the river and river/reservoir shallows would be searched for (a) potential exemplary natural communities and (b) target rare species.

Survey timing: One survey would be conducted in mid to late summer.

Data collection: The surveyor(s) will collect standard data using Natural Heritage methodology at each site where a rare element is located, using forms provided by NH and VT Natural Heritage programs.

- Plant species: data collected will include a count or estimate of individuals present, reproductive status (e.g., % of individuals flowering or fruiting), and a list of associated species. Population extent will be documented with GPS points at the upstream and downstream extent of each population. Specimens or diagnostic photographs will be collected as needed to confirm identification (following Natural Heritage guidelines for collecting rare plants).
- Natural communities: examples judged to potentially be exemplary (based on size, condition, and landscape context) will be documented using Natural Heritage forms. Classification of natural community types should follow NHB's 2011 classification (Sperduto, Daniel and William Nichols. 2011. Natural Communities of New Hampshire. Second Edition. NH Natural Heritage Bureau. Concord, NH.). Final determination of exemplary status will be made by Natural Heritage ecologists based on field data collected during the survey and GIS analysis of landscape context.

Effort and Cost
This study will require significant effort due to the total length of the project area (approximately 130 miles). Costs will largely be based on staff time and transportation expenses.

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March 1, 2013

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

Subject: Comments on Scoping Document 1 and Study Requests for the Wilder (FERC No. 1892-026), Bellows Falls (FERC No. 1855-045), Vernon (FERC No. 1904-073), and Turners Falls (FERC No. 1889-081) hydroelectric projects, and the Northfield Mountain Pumped Storage Project (FERC No. 2485-063)

Dear Secretary Bose:

The Nature Conservancy is submitting this letter in response to the December 21, 2012 Federal Energy Regulatory Commission (Commission) filing of the Notice of Intent to File License Application, Filing of Pre-Application Document (PAD), Commencement of Pre-Filing Process, and Scoping; Request for Comments on the PAD and Scoping Document, and Identification of Issues and Associated Study Requests for the Wilder, Bellows Falls, Vernon, and Turners Falls hydroelectric projects, and the Northfield Mountain Pumped Storage Project.

The Nature Conservancy (Conservancy) is a private, non-profit 501(c)3 organization with approximately 1 million members worldwide. The Conservancy has been working in the Connecticut River basin for over 50 years, officially establishing the Connecticut River Program in 2003 with a vision to protect and conserve the lands and waters of this important watershed in a way that allows both human and natural communities to thrive.

The Conservancy is a science-based organization that works with partners to identify and implement solutions to complex conservation challenges. Specifically, the staff of the Conservancy's Connecticut River Program has expertise in managing complex issues that correspond to effects of altered hydrological regimes on natural river hydrology, floodplain forest communities, and aquatic species assemblages, as well as expertise in developing management and conservation solutions for complex multiple-use river systems.

The Conservancy is interested in providing information and expertise that will assist the Commission in conducting a thorough and balanced analysis of the issues and effects surrounding the relicensing of the five hydropower projects on the Connecticut River. Because much of the information that we will provide applies to multiple projects, we are submitting this single document to comment and to address issues for all five of the Connecticut River projects. The comments and information herein are based on a review of the three Pre-Application Documents (PADs) submitted by TransCanada and the single PAD submitted by FirstLight on October 31, 2012, as well as the Commission's Scoping Document 1 (SD1) issued December 21, 2012, and the content of the scoping meetings held January 29-31, 2013.

COMMENTS ON SCOPING DOCUMENT 1

Section 3.0: Proposed Action and Alternatives

The SD1 states that "Commission staff will consider and assess all alternative recommendations for operational or facility modifications, as well as PM&E measures identified by the Commission, the agencies, Indian tribes, NGOs, and the public." Operational or facility modifications that the Conservancy recommends will support our overall goal to provide more natural flows in the Connecticut River that support floodplain forests, riparian invertebrates, freshwater mussels, and resident and migratory fish. In recognition of the importance of hydropower as a reliable and clean (i.e., having low carbon emissions) energy source, the Conservancy also seeks license recommendations that balance and optimize the competing values of both hydropower and ecosystem flow requirements.

In partnership with the U.S. Army Corps of Engineers, the University of Massachusetts Amherst (UMass), and the U.S. Geological Survey, the Conservancy is nearing completion of the federally-sponsored Connecticut River Watershed Study. The goal of the Study is to develop a series of models that seek to find optimal solutions for managing flows in the Connecticut River Watershed – solutions that balance both societal needs for water and power as well as natural flows that support ecological needs. As part of the Connecticut River Watershed Study, UMass has developed an hourly-based hydrological optimization model that, in concert with an operational simulation model, will provide the basis for the Conservancy's recommendations for alternative operational modifications to the five Connecticut River relicensed facilities. We propose that the Commission evaluate the alternative(s) that the Conservancy recommends based on model results; we anticipate these results will be further improved by data gathered during the First and Second Study Seasons of the relicensing process.

Furthermore, because of the uncertain and dynamic nature of ecological systems, we suggest that after completion of the two Study Seasons, the Commission recommend a course of adaptive management in those cases where the links between project operations and ecological benefit remain uncertain, or when results demonstrate that climate change effects will alter the nature of these links. An adaptive approach to management is beneficial to meeting ecosystem requirements, but also minimizes the risk of adopting an operational regime that results in loss of power generation or operational flexibility while also failing to meet ecological goals, a possible scenario in an uncertain and dynamic system. An adaptive-type approach to finding operational solutions will ultimately benefit all competing system objectives – both those of power generation and those of ecological needs.

Section 3.6.3: Project Decommissioning

The SD1 states that "[t]here would be significant costs involved with decommissioning the project and/or removing any project facilities. The project provides a viable, safe, and clean renewable source of power to the region. With decommissioning, the project would no longer be authorized to generate power." We concur with these statements; however, whereas there may be significant costs to decommissioning and removing project facilities, it is not clear whether these costs outweigh any potential resulting ecological benefits. Furthermore, project removal does not necessarily require a net loss of energy production. For example, dam removal on the Penobscot River in Maine has been accompanied by an increase in energy production capacity at other facilities (FERC 2004).

The SD1 also states that "No party has suggested project decommissioning would be appropriate in this case, and we have no basis for recommending it." We would like to note that before the scoping meetings and the issuance of the SD1, there was no formal avenue to suggest decommissioning in the FERC relicensing process. Therefore, the alternative of decommissioning should not be removed from consideration because of lack of prior suggestion. The Conservancy does not necessarily support decommissioning, especially without adequate study as to its benefits. However, eliminating this alternative from consideration limits the scope for finding solutions that balance the values and uses of the Connecticut River.

Section 4.1.1: Resources that could be cumulatively affected

As stated in the SD1 "…a cumulative effect is the effect on the environment that results from the incremental effect of the action when added to other past, present and reasonably foreseeable future actions…" The SD1 identified the following as potential cumulatively affected resources: water quality and quantity, fishery resources, and rare, threatened, and endangered species. The Conservancy agrees with this assessment and also suggests adding freshwater mussels and floodplain communities to this list. Support and justification for the inclusion of water quantity, fishery resources, freshwater mussels, and floodplain communities in the assessment of cumulatively-affected resources follows below.

Water quantity – For the context of the relicensing of the five Connecticut River hydropower projects, we suggest that water quantity be defined as a multi-dimensional resource; that is, it should not be defined simply by volume of water (flow magnitude), but also by how often (flow frequency), how long (flow duration), when (flow timing), and how quickly (rate of change in flow) these volumes of water move through the system (Poff et al. 1997). These water quantity characteristics are important not only as components of a natural flow regime, but also with regard to hydropower operational flows, being essential for both optimizing hydropower production and for meeting requirements of the riverine-dependent ecosystem.

Water quantity may be regarded as a cumulatively-affected resource because of flow modifications by upstream hydropower and flood control projects, impacts of relicensed projects on downstream water quantity, land use activities within the drainage area, and potential climate-induced changes in flow. Furthermore, because water quantity is a cumulatively-affected resource, then it logically follows that any resource directly dependent upon water quantity and its descriptive characteristics (see above) must therefore also be a cumulatively-affected resource. The most simple and direct example of this is that of power production, as energy production is directly related to the volume of water that passes through a hydropower turbine. There are other resources that are dependent upon water quantity that are also important, though the dependencies may be more complex, including fishery resources, freshwater mussels, and floodplain communities.

Fishery resources – The cumulative nature of the effects on migratory fish species is relatively clear: the effects of one project or barrier to upstream or downstream migration will be influenced by the effects of previous barriers along the migration route. Furthermore, multiple additional factors may affect migratory fish, including commercial fishing and conditions in the marine environment. Equally important is the cumulative nature of the effects on non-migratory resident fish species. Resident fish species may be considered cumulatively-affected for at least two reasons. First, because all riverine-dependent species have life-history characteristics that are dependent on the natural patterns of the flow regime (Poff and Ward 1990; Poff et al. 1997; Bunn and Arthington 2002), and because flow regime (water quantity and its descriptive characters) is a cumulatively-affected resource, then as stated above, any flow-dependent ecological resource must also be cumulatively-affected. Second, the definition of the biologically- or ecologically-relevant unit for a resource will determine whether that resource is cumulatively affected, at least on a spatial scale. For example, if we define the biologically-relevant unit of a particular fish species to be the population within a project reservoir, then the degree to which this resource is cumulatively affected is much less than if we defined the population to include all individuals of the species within the Connecticut River basin. If we choose to use the latter definition, then spatial cumulative effects would include modified flows from dams within the watershed, habitat fragmentation, land use, and invasive species, among other effects. We suggest that in the present context, the biologically-relevant unit for each species of non-migratory fish should include the population of all individuals of each species within the project-affected areas[1] for all five relicensed projects. With this definition, cumulative effects would include effects of the individual relicensed facilities, as well as upstream and tributary modified flows, habitat fragmentation, thermal effects from Vermont Yankee, and land use activities within the project-affected areas, among other potential effects.

There are at least two benefits to considering biologically-relevant units on this suggested larger scale. First, doing so expands the decision context and presents more opportunities for meeting broader ecological objectives, such as minimizing overall extinction risk or maximizing long term population stability. Managing flows at multiple facilities will present more opportunities to meet these broad scale objectives than managing flows at independent facilities for fragments of a larger population. The second benefit to considering populations on a broader scale is that the degree of information obtained and therefore the strength of conclusions will be greater than it would on a smaller scale. The conclusions made about the effects of one project on a resource will be made stronger by examining the effects of similar projects. Furthermore, without understanding the larger context, it becomes more difficult to elicit other non-project-related effects, such as unrelated thermal effects or land use activities. By considering populations on a broader scale and by examining the cumulative impacts on these populations, more information and better decisions can be made regarding whole-system management.

Freshwater mussels – Using the same rationale as described above for resident fish species, we propose that the Commission include freshwater mussels in its assessment of cumulatively-affected resources. In addition, we propose that the biologically-relevant unit for each mussel species be defined as the population that includes all individuals within the project-affected areas for all five relicensed projects.

Floodplain communities – We also propose that the Commission consider floodplain communities in its assessment of cumulatively-affected resources. In a comprehensive regional analysis, alluvial wetlands, such as floodplain forests and river marshes, emerged as the wetland type of greatest concern; 27 percent of their historic extent has been converted, mostly to agriculture. Although 15 percent of the historic area is now secured, only 6 percent is secured

[1] The project-affected area for each project is here considered the full longitudinal (upstream) and lateral (tributary) extent of the project impoundment, as well as the riverine reaches downstream of each project that are affected by the operational flow regime.

primarily for nature, so conversion exceeds securement for nature 5:1 (Anderson and Olivero Sheldon 2011). Flood-dependent tree species like silver maple and black willow occur only in low floodplain forests, while some tree species such as northern hackberry are nearly absent from the Connecticut River basin except on the rich soils of high floodplain terraces (C. Marks, The Nature Conservancy, personal communication). These communities depend on specific inundation regimes that are impacted by management of project reservoirs and potentially downstream flow management as well. If we consider the biologically-relevant unit to be the vegetative communities of the 100-year floodplain (as defined by the Federal Emergency Management Agency, FEMA) adjacent to project-affected areas for all five relicensed projects, cumulative effects on this resource include reservoir and flow management of each relicensed project, upstream and tributary modified flows, invasive species, and land use activities, among other potential effects.

Section 4.1.2: Geographic scope

The Conservancy suggests that in terms of water resources, the downstream geographical extent of a cumulative effects analysis should extend to, and include discharge from, Holyoke Dam in Holyoke, Massachusetts.

In terms of resident fish species and freshwater mussels, we suggest that the geographical extent of cumulative effects should include at minimum the entire project-affected area, from the upstream extent of Wilder reservoir downstream to Sunderland, Massachusetts. However, it is possible that the geographical extent of analysis will need to be lengthened in order to draw any conclusions regarding effect, given the limited riverine habitat within the project-affected areas.

We suggest that the geographical extent of cumulative effects on floodplain communities should include the 100-year floodplain (as defined by FEMA) adjacent to the project-affected area from the upstream extent of the Wilder reservoir downstream to the Route 116 bridge in Sunderland, Massachusetts.

Section 4.1.3: Temporal scope

We suggest that the temporal scope of cumulative effects include potential impacts of future climate change on a 30-50 year time frame. As part of the Connecticut River Watershed Study, researchers at the University of Massachusetts at Amherst have developed models that estimate predicted climate-impacted flows throughout the Connecticut River basin (Polebitski et al. 2012). We suggest that these models be used to evaluate temporal cumulative effects on the resources mentioned above with regard to climate-induced changes in the flow regime.

Section 5.0: Proposed Studies

In each of their PADs, and as noted in SD1, TransCanada has proposed to "[d]evelop a system operations model to assist in the evaluation of project effects." Whereas we recognize the necessity and value for the licensees to develop independent models, we suggest that because water quantity is a cumulatively-affected resource, evaluation of effects should also be considered on a whole-system scale (encompassing all relicensed facilities) and/or in a modeling framework that is consistent across all relicensed facilities (for example, in a framework such as that developed by the Connecticut River Watershed Study).

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STUDY REQUESTS

In response to the request for information and studies presented in the SD1, the Conservancy offers the following study requests to provide pertinent information for the preparation of the Environmental Impact Statement and for potential development of new license requirements. In addition, we strongly support the studies requested by the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, the Connecticut River Watershed Council, and the State resource management agencies in Vermont, New Hampshire, and Massachusetts, including the various study requests focused on improving fish passage at each of the projects. The following study requests are reflective of those areas of study in which the Conservancy has particular interest and expertise, but we acknowledge the likely need for additional studies in these and other research areas.

Requested Study 1: Evaluation of Project Effects on Impoundment Water Surface Elevations and River Flow Regime

Projects: Wilder (FERC No. 1892-026), Bellows Falls (FERC No. 1855-045), Vernon (FERC No. 1904-073), and Turners Falls (FERC No. 1889-081) hydroelectric projects, and the Northfield Mountain Pumped Storage Project (FERC No. 2485-063)

Goals and Objectives

§5.9(b)(1) – *Describe the goals and objectives of each study proposal and the information to be obtained*.

The goal of this study is to evaluate the effects of current and potential future project operations of the Wilder, Bellows Falls, Vernon, Turners Falls, and Northfield Mountain Pumped Storage hydroelectric projects on impoundment water surface elevations and the river flow regime.

Specific objectives of this study include:

1. To develop hourly hydrological simulation models of project operations for the Wilder, Bellows Falls, Vernon, Turners Falls, and Northfield Mountain Pumped Storage hydroelectric projects.
2. To evaluate the effects of existing operations for all five projects, including minimum flow, water level fluctuation restrictions (maximum and minimum pool levels), and other operational requirements on:

   a. Hourly reservoir water surface elevations of the Wilder, Bellows Falls, Vernon, and Turners Falls impoundments;
   b. Hourly discharge from the Wilder, Bellows Falls, Vernon, Turners Falls, and the Northfield Mountain Pumped Storage projects;
   c. Hourly withdrawals of the Northfield Mountain Pumped Storage project from the Turners Falls impoundment;
   d. Hourly reservoir water surface elevations of the Holyoke hydroelectric project (FERC No. 2004); and
   e. Hourly discharge from the Holyoke hydroelectric project (FERC No. 2004).
3. To evaluate and compare the effects of potential operational and flow modifications on items 2a-2e above; potential modifications will include:
   a. Recommendations for operational and flow modifications that result from studies conducted during the first and second Study Seasons;
   b. Recommendations for operational and flow modifications put forth by the Commission, federal, state, or local resource agencies, Native American tribes, non-governmental organizations, or the public; and
   c. Recommendations for operational and flow modifications based on optimization model results of the Connecticut River Watershed Study, a joint study of the Conservancy, UMass, U.S. Army Corps of Engineers, and the U.S. Geological Survey.
4. To evaluate the potential effects of climate-altered flows on current and potential project operations and corresponding effects on items 2a-2e above.

Relevant Resource Management Goals and Public Interest Considerations

§5.9(b)(2) – *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied*

Not applicable.

§5.9(b)(3) – *If the requestor is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.*

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a given project is located. In making its license decision, the Commission must equally consider the environmental, recreational, fish and wildlife, and other non-developmental values of a project, as well as power and developmental values.

The mission of The Nature Conservancy is to conserve the lands and waters on which all life depends. We have over 30,000 members in the Connecticut River Basin and have assisted in the protection of 350,000 acres in the watershed, currently managing approximately 13 preserves. Through the relicensing process, the Conservancy will seek solutions that will restore natural patterns of the Connecticut River's flow regime to support floodplain forests, riparian invertebrates, freshwater mussels, and resident and migratory fish. Natural patterns of river flow are critical to the life history of all riverine-dependent organisms and to the structure and function of riverine-dependent communities. Providing flows that mimic natural hydrological patterns will lead to healthier and more persistent populations and communities. Understanding project effects on the river's natural flow regime is necessary to understand project effects on the river ecosystem. Therefore, ensuring that the effects of project operations on the river flow regime are considered in a reasoned way is relevant to the Commission's public interest determination.

Existing Information and Need for Additional Information

§5.9(b)(4) – *Describe the existing information concerning the subject of the study proposal, and the need for additional information.*

The information available in the PADs does not indicate how project operations have altered river hydrology, which may affect resident and migratory fish, macroinvertebrates, rare, threatened and endangered species, aquatic plants, and other biota and natural processes in the Connecticut River. It is also unclear how project operations at one facility affect the operations at another.

Project Nexus

§5.9(b)(5) – *Explain any nexus between project operations and effects (direct, indirect, or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.*

The Wilder, Bellows Falls, Vernon, and Turners Falls projects are each currently operated with required minimum flows. The Turners Falls project is also operated with a seasonally-varying minimum bypass flow; there is presently no required minimum flow for the bypassed reach of the Bellows Falls project. Each of these projects operates as a daily peaking facility, such that flows can vary between the minimum required flows and total hydraulic capacity on a daily basis. In addition, Northfield Mountain pumped storage project operates by withdrawing water from the Turners Falls pool and releasing it back into the reservoir during peak generation hours. Furthermore, project operations and potential changes in operations to mitigate impacts at each facility are influenced by inflows and operations of upstream projects.

The operations of these five projects may affect riverine-dependent biota and associated habitat both upstream and downstream of each project by altering the natural patterns of the river's hydrological regime. Study results will provide necessary information regarding the extent of project effects on river hydrology, potential modifications to discharge and reservoir elevation operations, how such changes may be constrained by inflows and upstream project operations, and how these changes may impact natural hydrological patterns. This information may then be used to develop flow-related license requirements and/or other mitigation measures.

Proposed Methodology

§5.9(b)(6) **–** *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.*

Hourly hydrological operations modeling and river hydrology analyses are commonly employed at hydroelectric projects to assess implications of project operations on the river environment. As stated in the PADs, both licensees have developed or are planning to develop hydrological operations models for the relicensed projects. Whereas it is valuable to have separate models for the sake of comparison, given the cumulative nature of project effects on river hydrology, this study would ideally be done within the same modeling framework (for example, in a framework such as that developed by the Connecticut River Watershed Study). Modeled inflows should reflect current operational regimes if applicable (e.g., Fifteen Mile Falls, FERC No. 2007). Climate-altered flows should be based on the output of the Connecticut River Watershed Study variable infiltration capacity (VIC) models (Polebitski et al. 2012).

Level of Effort and Cost

§5.9(b)(7) **–** *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

Level of effort and cost of model development are expected to be moderate as much of the baseline modeling has already been completed, but evaluation of various operational scenarios will be needed throughout the relicensing process to assess the implications of changes to the hydrological regime. The modeling exercise will also require coordination and cooperation between both licensees to assure that the modeling framework is consistent and compatible among the relicensed projects.

We would anticipate that the expected level of effort and anticipated costs will be comparable to that experienced on similar FERC relicensing projects.

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Polebitsi, A., K. O'Neil, and R. Palmer. 2012. Connecticut River Basin variable infiltration capacity model. Report prepared for The Nature Conservancy, Connecticut River Program, Northampton, MA.

Requested Study 2: Instream Flow Habitat Assessment

Projects: Wilder (FERC No. 1892-026), Bellows Falls (FERC No. 1855-045), Vernon (FERC No. 1904-073), and Turners Falls (FERC No. 1889-081) hydroelectric projects

Goals and Objectives

§5.9(b)(1) – *Describe the goals and objectives of each study proposal and the information to be obtained*.

The goal of this study is to evaluate the effects of project operations on the availability and persistence of habitat for high-priority/target aquatic resources below the Wilder, Bellows Falls, Vernon, and Turners Falls projects, including the bypassed reaches of the Bellows Falls and Turners Falls projects, and to identify appropriate flow regimes that will protect and enhance the habitat for these aquatic resources.

Specifically, the objective of this study is to conduct an instream flow habitat study that will

1. Identify optimal habitat for target species; and
2. Determine the effects of the full range of project operations on the spatial and temporal availability and persistence of this habitat.

Relevant Resource Management Goals and Public Interest Considerations

§5.9(b)(2) – *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied*

Not applicable.

§5.9(b)(3) – *If the requestor is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.*

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a given project is located. In making its license decision, the Commission must equally consider the environmental, recreational, fish and wildlife, and other non-developmental values of a project, as well as power and developmental values.

The mission of The Nature Conservancy is to conserve the lands and waters on which all life depends. We have over 30,000 members in the Connecticut River Basin and have assisted in the protection of 350,000 acres in the watershed, currently managing approximately 13 preserves. Through the relicensing process, the Conservancy will seek solutions that will restore natural patterns of the Connecticut River's flow regime to support floodplain forests, riparian invertebrates, freshwater mussels, and resident and migratory fish. Natural patterns of river flow are critical to the life history of all riverine-dependent organisms, in large part because river flow is responsible for the patterns of habitat persistence and availability required for refuge, feeding, reproduction, and juvenile rearing of riverine-dependent organisms. Consequently, providing flows that mimic natural hydrological patterns will lead to healthier and more persistent populations and communities. Understanding project effects on the availability and persistence of critical habitat for target species is necessary to understand project effects on the river ecosystem. Therefore, ensuring that these effects on critical habitat are considered in a reasoned way is relevant to the Commission's public interest determination.

Existing Information and Need for Additional Information

§5.9(b)(4) – *Describe the existing information concerning the subject of the study proposal, and the need for additional information.*

In the PADs for the Wilder, Bellows Falls, and Vernon projects, TransCanada notes that an evaluation of aquatic macrohabitat was conducted in conjunction with the Yoder et al. (2009) fish assemblage study (p. 3-66, p. 3-77, and p. 3-96 in the Wilder, Bellows Falls, and Vernon PAD, respectively). However, this evaluation was qualitative and was not linked to project operations. Furthermore, there has been no evaluation of aquatic habitat in the Bellows Falls bypassed reach.

According to the PAD for the Turners Falls and Northfield Mountain Projects, FirstLight "conducted a characterization and mapping of aquatic mesohabitat (habitat classes) in the bypass reach from Turners Falls Dam to the Cabot Station discharge and the approximately 30 mile long segment of the Connecticut River from Cabot Station down to the vicinity of Dinosaur Footprints

Reservation." Whereas study results may be useful for some purposes, the resulting information is not sufficient to fully evaluate the effects of project operations on aquatic habitat for target species. The habitat designations in the FirstLight study were qualitative, were evaluated under only a single discharge regime, and were not directly linked to habitat requirements for target species. To adequately assess the effects of project operations on aquatic habitat, an instream habitat study should be quantitative, should be tied directly to specific known or hypothesized habitat requirements for target species, and should be conducted under conditions that characterize the full range of operational flows.

The Wilder, Bellows Falls, and Vernon projects, and Cabot Station at the Turners Falls project are each operated as daily peaking facilities, such that flows can vary between the minimum required flows and total hydraulic capacity on a daily basis. Except for the seasonally-varying minimum flow in the Turners Falls bypassed reach, which is intended to facilitate movement of migratory fish and provide some protection for shortnose sturgeon, the PADs for these projects do not indicate how minimum flow requirements were established or what specific ecological resources they are intended to benefit. None of the established minimum flows, including those provided in the Turners Falls bypassed reach, have been based on quantitative, rigorous scientific studies. However, some information does exist regarding minimum flows necessary for shortnose sturgeon spawning and rearing at the Rock Dam in the bypassed reach (Kynard et al. 2012). Spawning success was observed at the Rock Dam when discharge was between 2,500 and 22,000 cfs during the spawning period of April 27 through May 22 (Kynard et al. 2012, chapter 3). This data would suggest that current minimum flows in the Turners Falls bypassed reach are not sufficient to support the continued success of shortnose sturgeon in this river reach.

Other than the observations regarding sturgeon spawning success, we are not aware of any other studies that have evaluated the adequacy of the minimum flows in the Turners Falls bypassed reach, or of the minimum flows at Cabot Station or any of the upstream projects, in protecting aquatic resources and habitat downstream of these projects. Nor are we aware of any studies that have evaluated project effects of daily hydropeaking on the riverine habitat in these river reaches. Therefore, in order to fill this important information gap, an empirical study is needed to provide information on the relationship between flow and habitat in the Connecticut River downstream of the Wilder, Bellows Falls, Vernon, and Turners Falls projects, including in the bypassed reaches of the Bellows Falls and Turners Falls projects.

Project Nexus

§5.9(b)(5) – *Explain any nexus between project operations and effects (direct, indirect, or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.*

The distance from the upstream end of the Wilder impoundment downstream to the Route 116 bridge in Sunderland, Massachusetts (the headwaters of the Holyoke pool) is 150 miles. A total of 117 miles (78%) of this segment is impounded. The remaining riverine habitat is within the 17 miles downstream of Wilder dam, the 6 miles downstream of Bellows Falls, the 10 miles downstream of Cabot Station (Turners Falls), and potentially a short distance downstream of Vernon Dam (at the scoping meetings, FirstLight indicated that their project assessment may provide evidence that the upstream extent of the Turners Falls impoundment may not reach all the way to Vernon Dam). Because most of the lotic (flowing water) habitat in this section of the Connecticut River has been converted to lentic (still water) habitat, the remaining lotic habitat is critical to sustaining the populations and communities of riverine-dependent species in these river reaches, including American shad and the federally-endangered shortnose sturgeon and dwarf wedgemussel. It follows that understanding the effects of project operations on this habitat is also critical to sustaining these populations and communities.

Additionally, there are two river reaches from which flows have been bypassed into power canals, a 3,500-foot long bypassed reach at the Bellows Falls Project and a 2.7-mile long bypassed reach at the Turners Falls Project. The current license of the Bellows Falls Project does not require any minimum flows in the bypassed reach, such that it only receives flow when inflow exceeds the project's hydraulic capacity, about 30% of the time on an annual basis. These flows do not sufficiently protect the aquatic resources inhabiting or potentially inhabiting this reach of river. Furthermore, the channel morphology and substrate of the Bellows Falls bypass channel is complex and variable, consisting of coarse substrate of various sizes as well as jagged, irregular ledge. Such heterogeneous physical habitat could provide aquatic habitat conditions that are now rare in the Connecticut River due to extensive impoundment of lotic habitat, and are therefore of great conservation value.

Unlike the Bellows Falls bypassed reach, the Turners Falls bypassed channel is currently operated with a seasonally-varying minimum flow (200 cfs starting on May 1, increasing to 400 cfs when fish passage starts through to July 15, then reduced down to 120 cfs until river temperature drops below 7°C). However, these flows were not based on any quantitative, rigorous scientific studies. This section of the Connecticut River contains habitat that supports native riverine species, including spawning and rearing habitat for the federally endangered shortnose sturgeon. It is unlikely that the current minimum flow regime sufficiently protects the aquatic resources, including endangered species, inhabiting the bypassed reach.

The Wilder, Bellows Falls, Vernon, and Turners Falls (Cabot Station) projects are also currently operated with minimum flow releases that were not based on biological criteria or field study.

These continuous minimum flows are only equal to about 40% of the Aquatic Base Flow[2]. Given the variability that is characteristic of the natural flow regime upon which all riverine species depend (Poff et al. 1997, Bunn and Athington 2002), these minimum flows likely do not sufficiently provide the range of habitat requirements for downstream aquatic resources. Furthermore, these projects generate power in a peaking mode resulting in substantial within-day flow fluctuations between minimum flows and project capacity. Large and rapid changes in flow releases from peaking hydropower dams have been shown to cause adverse effects on downstream habitat and biota (Cushman 1985, Blinn et al. 1995, Freeman et al. 2001).

Understanding the effects of the range of operations at each of these facilities and in the bypassed reaches will assist in determining appropriate flow recommendations that will protect and/or enhance the aquatic habitat and the corresponding target species in the river downstream of each project.

Proposed Methodology

§5.9(b)(6) – *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.*

Instream flow habitat assessments are commonly employed in developing operational flow regimes that will reduce the impacts to or enhance habitat conditions downstream of hydroelectric projects. We request that an instream flow habitat assessment be conducted in the following areas: in the approximately 17 miles between the Wilder Dam and the headwaters of the Bellows Falls pool, in the 3,500-foot long bypassed reach downstream of Bellows Falls Dam, in the approximately 6 miles between the Bellows Falls Project and the headwaters of the Vernon pool, in the approximately 1.5 miles between the Vernon Dam and the downstream end of Stebbins Island (or the upstream extent of the Turners Pool as determined by FirstLight, whichever river length is greater), in the 2.7-mile long bypassed reach downstream of Turners Falls Dam, and in the approximately 10 miles between Cabot Station and the Route 116 bridge in Sunderland, Massachusetts.

We suggest the use of a methodology similar to that of an Instream Flow Incremental Methodology (IFIM; Bovee et al. 1998) approach. A similar protocol was used during the

[2] The Aquatic Base Flow equates to the August Median Flow as determined using unregulated hydrography or on drainage area at the project site (0.5 cfs per square mile of drainage area) if unregulated hydrography is unavailable.

relicensing of the Housatonic River Project (FERC No. 2576)[3], and has been accepted by the Commission in other licensing proceedings[4].

The study design should involve collecting habitat data specific to the known or hypothesized habitat requirements of target species, including but not limited to depth, velocity, and substrate composition. Target species will include, but are not limited to, shortnose sturgeon, American shad, fallfish, white sucker, yellow perch, smallmouth bass, walleye, dwarf wedgemussel and other freshwater mussels, and benthic macroinvertebrates. Target species and measured habitat components should be determined during the development of the study plan in consultation with fishery agencies and other parties.

Habitat modeling using standard PHABSIM 1-dimensional modeling should be conducted in the deep, homogeneous, straight-channel areas of the specified river reaches mentioned above. Two-dimensional hydraulic modeling should be conducted in the sections of river with more heterogeneous habitat and complex features such as islands, braiding, falls, and shallow-water shoals. For example, 2-dimensional modeling should be conducted for the entire reach of the Bellows Falls bypassed channel, for the Turners Falls bypassed channel from the spillway and mouth of the Falls River to the point where the channel constricts, and for the reach downstream from Cabot Station to the railroad bridge below the mouth of the Deerfield River.

Measurements should be taken over a range of flows sufficient to model the full extent of the operational flow regime. In the Turners Falls bypassed reach this should include a range of flows that will allow for modeling flows up to 6,300 cfs. The upper range of flows for the Bellows Falls bypassed reach should be determined during the development of the study plan in consultation with fishery agencies and other parties. Collected information should then be synthesized to quantify habitat suitability (using mutually agreed-upon habitat suitability index (HSI) curves) over a range of flows for target species. Data should be collected in such a way that allows a dual-flow analysis and habitat time series or similar approaches that will permit assessment of how temporal and spatial availability and persistence of habitat for target species changes over the range of flows that occur as part of the operational flow regime.

Level of Effort and Cost

§5.9(b)(7) – *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

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[3] Housatonic River Project License Application, Volume 4, Appendix F. Connecticut Light and Power Company, August 1999.

[4] Glendale Project (FERC No. 2801) Final Bypass Reach Aquatic Habitat and Instream Flow Study in Glendale Hydroelectric Project Application for Subsequent License (FERC No. 2801), Volume 2, Appendix B, pages 7-8, October 2007.

Field work for instream flow studies can be extensive, but will depend on consultation with the applicant on study methodology and on-site decisions on locations for data collection and the number of collection locations. Use of laser measurements, GPS, and/or an Acoustic Doppler Current Profiler (ADCP, if available) can improve efficiency and accuracy of field measurements. Post-fieldwork data analysis would be of moderate cost and effort. We anticipate that the level of effort and cost will be comparable to that of other FERC relicensing projects of similar size to these projects.

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Requested Study 3: Impacts of Water Level Fluctuations on Floodplain, Wetland, Riparian, and Littoral Vegetation Communities and Habitats

Projects: Wilder (FERC No. 1892-026), Bellows Falls (FERC No. 1855-045), Vernon (FERC No. 1904-073), and Turners Falls (FERC No. 1889-081) hydroelectric projects, and the Northfield Mountain Pumped Storage Project (FERC No. 2485-063)

Goals and Objectives

§5.9(b)(1) – *Describe the goals and objectives of each study proposal and the information to be obtained*.

The goal of this study is to evaluate the effects of project operations on floodplain, wetland, riparian, and littoral vegetative communities and habitats both upstream and downstream of the Wilder, Bellows Falls, Vernon, and Turners Falls projects (and including the effects of the Northfield Mountain Pumped Storage project), and to identify appropriate project operations that will protect and enhance these communities and habitats.

Specifically, the objectives of this study are to:

1. Delineate, quantitatively describe, and map vegetative communities from the shoreline to the extent of the 100-year floodplain;
2. Delineate, quantitatively describe (e.g., substrate composition, vegetation type and extent of cover), and map littoral habitat types; and
3. Determine the effects of the full range of current and potential future operations of all five projects on the persistence of the communities and habitats described in items 1 and 2.

Relevant Resource Management Goals and Public Interest Considerations

§5.9(b)(2) – *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied*

Not applicable.

§5.9(b)(3) – *If the requestor is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.*

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a given project is located. In making its license decision, the Commission must equally consider the environmental, recreational, fish and wildlife, and other non-developmental values of a project, as well as power and developmental values.

The mission of The Nature Conservancy is to conserve the lands and waters on which all life depends. We have over 30,000 members in the Connecticut River Basin and have assisted in the protection of 350,000 acres in the watershed, currently managing approximately 13 preserves. Through the relicensing process, the Conservancy will seek solutions that will restore natural patterns of the Connecticut River's flow regime to support floodplain forests, riparian invertebrates, freshwater mussels, and resident and migratory fish. Natural patterns of river flow are critical to the life history of all riverine-dependent organisms and to the structure and function of riverine-dependent communities. Providing flows that mimic natural hydrological patterns will lead to healthier and more persistent populations and communities. Understanding project effects on the vegetative communities and habitats that depend on these patterns of flow is necessary to understand project effects on the river ecosystem. Therefore, ensuring that project effects on floodplain, wetland, riparian, and littoral vegetative communities and habitats are considered in a reasoned way is relevant to the Commission's public interest determination.

Existing Information and Need for Additional Information

§5.9(b)(4) – *Describe the existing information concerning the subject of the study proposal, and the need for additional information.*

Existing information in the TransCanada PADs regarding floodplain, wetland, riparian, and littoral vegetation and habitat is based on the National Wetlands Inventory, USGS landcover maps, and qualitative surveys and descriptions. As a result, some coarse delineation and mapping has been done and has been presented in the PADs. However, the mapping is too coarse to use to evaluate effects, and does not cover all habitat types in all areas. The PADs acknowledge that "[p]otential effects of the Project[s] on wetland, floodplain, riparian, and littoral resources can occur as a result of hydroelectric operations" (p. 3-104, p. 3-113, and p. 3-142 in the Wilder, Bellows Falls, and Vernon PADs, respectively). However at present, no studies have been done or are proposed to be done that examine the effects of project operations on these resources.

Existing information in the FirstLight PAD regarding floodplain, wetland, riparian, and littoral vegetation and habitat is based primarily on the National Wetlands Inventory and qualitative description of likely occurring community and habitat types. However, the delineations provided by the Wetlands Inventory are too course to use to evaluate project effects, and do not cover all habitat types. In the list of preliminary issues pertaining to the continued operation of the Turners Falls and Northfield Mountain, the FirstLight PAD notes the potential for project effects on botanical habitat (which includes floodplain communities) and wetland, riparian, and littoral zone habitat (p. 5-1). Additionally, the PAD documents a proposed study to conduct an inventory of botanical resources including a verification of the National Wetlands Inventory data. However at present, no studies have been done or are proposed to be done that examine the specific effects of project operations on these resources.

Project Nexus

§5.9(b)(5) – *Explain any nexus between project operations and effects (direct, indirect, or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.*

Because the structure and function of the vegetative communities that comprise floodplain, wetland, riparian, and littoral habitats are defined by the frequency, duration, depth, and timing of inundation, it follows that project operations that cause changes to patterns of inundation (by reservoir levels or downstream flows) could affect these communities and habitats. These effects would consequently impact the fish and wildlife species that depend on these habitats for spawning, juvenile rearing, feeding, and refuge. For example, when the shallow shoreline and bankside habitats of the littoral zone are regularly dewatered, juvenile fish are forced to occupy deeper, more open, and less productive habitat, resulting in slower growth and lower survival (McKinney et al. 2001, Korman and Campana 2009). An additional consequence to altered riparian vegetative communities is a reduction in the stability of underlying soils and sediments, potentially increasing the rate of bank erosion. Furthermore, operations may promote the introduction and expansion of invasive plant species through fluctuating water levels. A study that examines the effects of current and potential future project operations on the extent, duration, and persistence of floodplain, wetland, riparian, and littoral habitats will help inform license requirements to protect and enhance these resources.

Proposed Methodology

§5.9(b)(6) – *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.*

Frequency, duration, depth and timing of inundation determine the composition and type of floodplain, wetland, riparian, and littoral vegetation communities. For example, there is a general gradient that follows a trend from high terrace floodplain forest, to low floodplain forest, shrub swamp, herbaceous emergent marsh, and then to submerged aquatic vegetation. The interaction of topography and impoundment water level or flow regime determines the distribution and relative abundance of these communities.

To evaluate the effects of project operations on these vegetative communities and habitats, the study methods should include the following:

1. Obtain an accurate digital elevation model (e.g. ArcGIS raster) of valley topography in project-affected areas with a minimum 1-foot vertical resolution, which is required to at minimum to distinguish wetland habitat from upland. Topography data should extend between the minimum and maximum of reservoir operations under all possible scenarios, including potential changes to operations. Data should be collected from the upper extent of the Wilder reservoir downstream to the Route 116 bridge in Sunderland, Massachusetts, and should extend laterally from the lowest water level permitted within the operational range to the boundary of the 100-year flood plain as defined by the Federal Emergency Management Agency (FEMA).
2. Quantify critical thresholds in inundation regime (frequency, duration, depth, and timing) limiting the extent of the vegetative communities on the inundation gradient described above (Metzler and Damman 1985, Nislow et al. 2002). See also TNC's Connecticut River watershed-wide study of floodplain forests (C. Marks, The Nature Conservancy, in preparation). Specific defined community types should be determined during the development of the study plan in consultation with resource agencies and qualified subject ecologists.
    a. Identify at least 5 occurrences of each defined community type in each project impoundment (Wilder, Bellows Falls, Vernon, and Turners Falls) and, if possible, at least 5 occurrences in the downstream riverine portion of each project, for a total of 40 occurrences for each community type. Identify at least 5 locations in each of the impoundments and at least 5 locations in the downstream riverine portion of each project that are periodically inundated but lack the target communities. Existing sources mentioned in the PAD should help with identifying appropriate study sites.
    b. At each of these locations survey the elevations where the different communities occur/do not occur, paying particular attention to transitions.
    c. Develop hydraulic models (e.g., HEC-RAS; Nislow et al. 2002) for downstream riverine locations.
    d. Quantify the inundation regime for each of the study sites using impoundment water level and hydraulic model results.
    e. Using the above data calculate quantitative limits for the windows of inundation within which each of these community types occurs. Report all relevant statistics.

3. In GIS, predict distributions of the above riparian communities across the digital elevation model as a function of impoundment water levels and discharge using the statistical relationships developed in step 2. Complete this task using an existing software tool such as HEC-EFM developed by the US Army Corps of Engineers for this purpose (USACE 2013).
4. Verify the accuracy of the model by calculating how well it predicts known community occurrences. Once this is completed, use model outputs to examine how terrace elevation influences the amount of each defined community type that is available in the project areas under realistic alternative scenarios of impoundment water levels and discharge regimes.

Level of Effort and Cost

§5.9(b)(7) – *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

In their PAD, First Light identified impacts of the project operations on wetlands, riparian and littoral zone habitat as a potential issue to be addressed in relicensing, and proposed wetland vegetation mapping. However, additional analysis as described above is needed to understand the impacts of the project on these resources and habitats.

The cost of collecting the data for this study will be largely dependent on how the digital elevation models are developed. Otherwise, field sampling should require 2-3 people for 3-4 months, followed by 3-4 months of analysis by 1 person.

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Requested Study 4: Determine fish assemblage structure in project-affected areas

Projects: Wilder (FERC No. 1892-026), Bellows Falls (FERC No. 1855-045), Vernon (FERC No. 1904-073), and Turners Falls (FERC No. 1889-081) hydroelectric projects

Goals and Objectives

§5.9(b)(1) – *Describe the goals and objectives of each study proposal and the information to be obtained*.

The goal of this study is to determine the occurrence, distribution, and relative abundance of fish species present in the project-affected areas from the headwaters of Wilder reservoir to Sunderland, Massachusetts, an area which potentially includes Species of Greatest Conservation Need (SGCN) for New Hampshire, Vermont, and Massachusetts.

Specific objectives include:

1. Document fish species occurrence, distribution, and relative abundance within project-affected along spatial and temporal gradients; and
2. Compare historical records of fish species occurrence in the project-affected areas to the results of this study.

Relevant Resource Management Goals and Public Interest Considerations

§5.9(b)(2) – *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied*

Not applicable.

§5.9(b)(3) – *If the requestor is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.*

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a given project is located. In making its license decision, the Commission must equally consider the environmental, recreational, fish and wildlife, and other non-developmental values of a project, as well as power and developmental values.

The mission of The Nature Conservancy is to conserve the lands and waters on which all life depends. We have over 30,000 members in the Connecticut River Basin and have assisted in the protection of 350,000 acres in the watershed, currently managing approximately 13 preserves. Through the relicensing process, the Conservancy will seek solutions that will restore natural patterns of the Connecticut River's flow regime to support floodplain forests, riparian invertebrates, freshwater mussels, and resident and migratory fish. Understanding project effects on the communities of resident fish that inhabit project-affected areas first requires an understanding of the structure of the fish species assemblage within these areas. Therefore, determining the resource status of the resident fish species assemblage in project-affected areas is relevant to the Commission's public interest determination.

Existing Information and Need for Additional Information

§5.9(b)(4) – *Describe the existing information concerning the subject of the study proposal, and the need for additional information.*

A thorough and comprehensive assessment of the fish assemblage present in the project-affected areas is lacking. Whereas some sampling was conducted in all project-affected areas during a 2008 Connecticut River electrofishing survey (Yoder et al., 2009), this survey did not have the same goals and objectives as those outlined above. Due to the design of this study, limitations in geographic/habitat type coverage both spatially and temporally, and the use of a single gear type, the use of these data are limited and may not represent the full complement of species that occur in the project-affected areas. In addition, some fairly comprehensive fish surveys have been conducted in the Vernon pool, as referenced in the Vernon PAD. However, objectives and methodology for these fish surveys differ from those stated here, and gear types were generally limited to boat electrofishing which may not be suitable for properly assessing all species present in the project-affected areas.

The PAD for the Wilder project states "No targeted studies have been conducted to characterize the fish community in relation to the Project" (p. 3-42, Wilder PAD), and that of the Bellows Falls project similarly states "Little comprehensive information is available regarding characterization of the fish community in relation to the Project" (p. 3-50, Bellows Falls PAD). The PAD for the Turners Falls and Northfield Mountain Pump Storage projects cites resident fish surveys conducted by the State of Massachusetts in the early to mid-1970s and the 2008 sampling effort by Yoder et al. (2009). This PAD identifies a total of 22 fish species in the project area but omits northern pike, tessellated darter, burbot, and channel catfish, which are known to occur in this area (Ken Sprankle, USFWS, personal communication). It follows that since information is limited or lacking regarding the composition of the fish community and their use of habitats in the project-affected areas, project effects on the fish species assemblage are also unknown.

Project Nexus

§5.9(b)(5) **–** *Explain any nexus between project operations and effects (direct, indirect, or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.*

Project operations have the potential to directly impact fish species life history requirements, biological interactions, and habitat quantity and quality. For example, headpond and tailwater water level fluctuations could dewater important spawning areas, thus limiting productivity of fish species by direct impacts to their spawning success or indirectly by limiting the spawning success of forage fish species. Accordingly, a thorough understanding of the current fish assemblage structure and associated metrics are needed in order to examine any potential project-related impacts.

Proposed Methodology

§5.9(b)(6) **–** *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.*

An accepted and robust field sampling design (e.g., as described in Pollock et al. 2002 or MacKenzie et al. 2006) and accepted methods for collecting fish species likely to be present in the project-affected areas (Bonar et al. 2009) should be used to conduct field surveys. Randomly sampling multiple habitat types using a multi-gear approach will be required to ensure that all fish species present are sampled. The spatial scope of the study will be from the headwaters of Wilder pool downstream to Sunderland, Massachusetts, and will omit the upper reservoir of Northfield Mountain Pump Storage project. Sampling should occur at each selected site across multiple seasons (spring, summer, and fall). Digital photographs should be taken to avoid misidentification of certain species such as Cyprinids.

The sampling design should include replicate samples for estimation of species detection probability. Sample replicates may be gathered temporally, using different methods, by independent observers, or by randomly sampled spatial replicates (MacKenzie et al. 2006). For each replicate sample, data that may be important for describing variation in species occurrence and presence/absence should be collected and recorded, such as gear type, mesohabitat type, depth, velocity, water temperature, substrate, time of day, day of year, presence of cover, proportion of vegetation cover, size of individuals collected (juveniles may select different habitat), and/or other factors as determined by a qualified biologist. Species detection, occurrence, and/or abundance and potential effects of habitat on these parameters should be estimated using methods as described by Kery et al. (2005), MacKenzie et al. (2006), Wenger and Freeman (2008), or Zipkin et al. (2010).

A report should be prepared or supplemental material provided that includes:

- the specific location (coordinates) of each site and date /time of each sample,
- the measures of habitat variables that are collected at each site and for each sample,
- the type of gear used for each sample,
- the identity and length of each individual fish collected,
- photos of representative specimens of each collected species,
- estimates of species detection probability,
- estimates of species occurrence probability,
- estimates of species abundance, and
- tables of model selection results.

Based on first year study results, and on the results of other studies, additional studies examining impacts of project operations on specific fish species may be requested. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

Level of Effort and Cost

§5.9(b)(7) – *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

The cost of the study will be moderate to high as seasonal sampling with several types of gear will be required. However, cost will also be partially dependent on the number of sites sampled, the number of sample replicates, and the extent of the covariate data that are measured, all of which should be determined during the development of the study plan in consultation with fishery agencies and other parties. Based on study results of the first year of sampling, a second year of sampling may be requested, especially if natural environmental conditions are extreme (e.g., a drought or flood occurs). Provided the collected data are of high quality, analysis and synthesis should take approximately 10-20 days. Neither TransCanada nor FirstLight has proposed any studies specifically addressing this issue.

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Requested Study 5: Effects of the Wilder and Bellows Falls Projects on the Dwarf Wedgemussel (*Alasmidonta heterodon*)

Projects: Wilder (FERC No. 1892-026) and Bellows Falls (FERC No. 1855-045) hydroelectric projects

Goals and Objectives

§5.9(b)(1) – *Describe the goals and objectives of each study proposal and the information to be obtained*.

The goal of this study is to evaluate the effects of the Wilder and Bellows Falls hydroelectric projects on populations of the federally-endangered dwarf wedgemussel (*Alasmidonta heterodon*) and to develop measures to minimize adverse impacts to the dwarf wedgemussel in the future. The specific objectives of the study are as follows:

1. Conduct an initial survey of the free flowing stretch of the Connecticut River from the Wilder Dam to the upstream end of the Bellows Falls impoundment to determine the distribution of the dwarf wedgemussel in this reach.
2. Determine the best sites for intensive quantitative sampling of mussel communities, with emphasis on the dwarf wedgemussel. Data will be collected to estimate density (mussels per unit area) and age class structure for all species.
3. Lay the groundwork for a long-term monitoring program.
4. Document instream behavior of mussels during varying flow conditions.
5. Determine how availability and persistence of dwarf wedgemussel habitat changes with water level and flow fluctuations.

Relevant Resource Management Goals and Public Interest Considerations

§5.9(b)(2) – *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied*

Not applicable.

§5.9(b)(3) – *If the requestor is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.*

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a given project is located. In making its license decision, the Commission must equally consider the environmental, recreational, fish and wildlife, and other non-developmental values of a project, as well as power and developmental values.

The mission of The Nature Conservancy is to conserve the lands and waters on which all life depends. We have over 30,000 members in the Connecticut River Basin and have assisted in the protection of 350,000 acres in the watershed, currently managing approximately 13 preserves. Through the relicensing process, the Conservancy will seek solutions that will restore natural patterns of the Connecticut River's flow regime to support floodplain forests, riparian invertebrates, freshwater mussels, and resident and migratory fish. Natural patterns of river flow are critical to the life history of all riverine-dependent organisms and to the structure and function of riverine-dependent communities. As a federally-endangered species, the dwarf wedgemussel is of particular interest to the Conservancy. By understanding project effects on this species, we will begin to understand more about the patterns of flow that are necessary to support the larger river ecosystem. Ensuring that project effects on dwarf wedgemussel are considered in a reasoned way is relevant to the Commission's public interest determination.

Existing Information and Need for Additional Information

§5.9(b)(4) – *Describe the existing information concerning the subject of the study proposal, and the need for additional information.*

In 2011, Biodrawversity, LLC conducted a freshwater mussel survey throughout the Vernon, Bellows Falls, and Wilder project areas (Biodrawversity and LBG 2012). This survey was semi-quantitative (i.e. timed searches were used) and the main goal was to assess the distribution, abundance, demographics, and habitat of the dwarf wedgemussel in the project areas. Dwarf wedgemussel were found in the Wilder impoundment (all within a 14-mile stretch of the river beginning 27 miles upstream of the Wilder Dam) and Bellows Falls impoundment (located sporadically in the upper 17 miles of the impoundment); none were found in the Vernon project-affected area. These results corroborate the results of other studies performed in the past in these areas (Nedeau 2006a, Nedeau 2006b).

The 2011 survey did not include the 17-mile free flowing stretch of the Connecticut River downstream of Wilder Dam. The dwarf wedgemussel has, in the past, been found within this river reach, although overall there has been limited survey work in the area. A better understanding of the distribution and abundance of the dwarf wedgemussel in this stretch of the river is required before an evaluation of how the dam affects this species can be made. This need is represented in Objective 1.

Since the 2011 survey was semi-quantitative, it cannot be used as a basis for determining population estimates or trends (Wicklow 2005). In fact, few if any of the past surveys performed in the project-affected areas have employed quantitative methodology. In addition, there is little quantitative information regarding the age class structure, and therefore recruitment, of the mussel communities in the area. In order to demonstrate that a dwarf wedgemussel population is viable according to the Dwarf Wedgemussel Recovery Plan (USFWS 1993), it must have a large and dense enough population to maintain genetic variability and annual recruitment must be adequate to maintain a stable population. Thus, knowledge of population size and density as well as a better understanding of age class structure is a necessary step in determining the baseline status of dwarf wedgemussel populations. The 2011 survey and other surveys can be used to determine the best sites for implementing a monitoring program. This need is represented in Objective 2.

Once this baseline is established, it will be important to monitor the sites so that biologists can estimate and track changes to dwarf wedgemussel populations and/or evaluate any project-related population impacts. Therefore, there is a need to develop long-term monitoring plots that will be surveyed at regular intervals using methodology that is repeatable and yields quantitative, statistically valid results. This need is represented in Objective 3.

Flow conditions that result from dam operations may alter the behavior of individual dwarf wedgemussels or individuals of other species. Dam operations affect streamflow, temperature, and dissolved oxygen, and changes to these variables can often be rapid. It is not known how these rapid changes affect various aspects of a mussel's biology, including lure display, shell position (open/closed), siphoning rate, and vertical migration. This need is represented in Objective 4.

Dam operations can also affect the availability of habitat for mussels, and this availability can change quickly as water levels fluctuate under peaking operations. The persistence of habitat is a key element to the long-term success of sedentary lotic organisms such as the dwarf wedgemussel (Maloney et. al. 2012), which is unable to quickly move in response to rapid changes in its environment and can thus become stranded in areas of unsuitable habitat; however, there is currently no information concerning the relation of project operations to habitat persistence within the Wilder and Bellows project-affected areas. This need is represented in Objective 5.

Project Nexus

§5.9(b)(5) – *Explain any nexus between project operations and effects (direct, indirect, or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.*

It has been well documented that the damming of rivers can have detrimental impacts on the mussel communities that inhabit areas both upstream and downstream of dams (Watters 1999, Layzer et. al. 1993, Moog 1993). The dwarf wedgemussel is known to occur within the Wilder and Bellows Falls project areas and operations of these two dams may affect the viability of this species in the Connecticut River. This study plan will allow for a better understanding of how sub-daily flow and water level fluctuations influence dwarf wedgemussel abundance, available habitat, and behavior. This information can be used to inform the development of license requirements that can ensure the continued existence of this species within the project-affected areas.

Additionally, a long-term monitoring program of important dwarf wedgemussel sites within the project areas is necessary to evaluate any project-related population and/or behavioral impacts that may occur. This information can be used to inform decision makers in the future.

Proposed Methodology

§5.9(b)(6) – *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.*

A survey of the 17-mile reach between the Bellows Falls impoundment and the Wilder Dam is the logical first step of the study plan, and this can be done in well less than one field season. This may be treated as an extension of the Biodrawversity and LBG (2012) survey and the same semi-quantitative methodology may be used. Once completed, this survey will help fill in the knowledge gap that exists in the distribution of the dwarf wedgemussel within this reach of the Connecticut River. This proposed methodology corresponds to Objective 1.

Next, quantitative study plots should be established at sites throughout the two project-affected areas that are known to support the dwarf wedgemussel. Plots should be set up and surveyed using methodology that will allow for the estimation of population density and size. Smith et. al. (2001) have developed such a methodology, which is also outlined in Strayer and Smith (2003).

It is based on a double-sampling design (visual inspection of the substrate surface plus excavation of a random subset of quadrats) using 0.25 m2 quadrats that are placed systematically with multiple random starts. This protocol has been used to monitor dwarf wedgemussel populations at two sites on the Ashuelot River in Keene, NH (Nedeau 2004). A number of other recent studies have also made use of this protocol for different species of mussels (Fulton et. al. 2010, Crabtree & Smith 2009, Bradburn 2009).

Data to determine age class structure should also be collected at these selected sites. This would involve measuring the length and estimating the age (through external annuli counts) of each mussel sampled within a quadrat. Based on this information, an analysis of recruitment can be made. This field work and analysis was performed on the mussel community inhabiting the lower Osage River in Missouri as part of the relicensing process of the Osage Hydroelectric Project (FERC no. 459) (ESI 2003). The work done on the Osage can be used as a template for this study. Depending on how many plots are chosen, this phase of the study could take one or two field seasons. This proposed methodology corresponds to Objective 2.

The sites surveyed to meet Objective 2 should be resurveyed using the same methodology at regular intervals in the future so that any changes over time and/or over varied flow regimes can be evaluated. In addition, a mark-recapture pilot study should be initiated to evaluate the potential for using this methodology for long-term monitoring of dwarf wedgemussel abundance and survival. Mark-recapture methods provide statistically robust estimates of population parameters that are superior to simple count estimates in cases where it is not practicable to count all individuals in a population. Methods should be similar to those in Peterson et al. (2011), Meador et al. (2011), and Villella et al. (2004), but should focus on differences among sampled sites. Sites should be selected based on those sampled to meet Objective 2, but should also include sites outside of the project area to fully evaluate project effect and to account for any natural variability that may be independent of project effect.

A long-term mussel monitoring program was devised as part of the study plan for the relicensing of the Lake Blackshear Hydroelectric Project (FERC No. 659) on the Flint River, Georgia. According to the monitoring plan (Lake Blackshear Project 2009), three surveys will be conducted five years apart, beginning five years after issuance of the FERC license. Surveys will be quantitative (there is a qualitative aspect to the Lake Blackshear mussel monitoring plan that can be ignored) and will focus on evaluating changes in recruitment and population size of the purple bankclimber (*Elliptoideus sloatianus*), a federally-listed species. A similar protocol should be used to monitor dwarf wedgemussel populations in the project-affected areas of the Connecticut River post-license, although the number of surveys and the time between surveys may require some research and discussion. This proposed methodology corresponds to Objective 3.

In order to investigate the effects that the hydropower projects have on mussel behavior, individual mussels should be observed as flow fluctuates as a result of dam operations. Researchers should measure changes in shell position (open/closed), siphoning rate, lure display, horizontal migration (movement across the substrate), and vertical migration (burrowing). Past studies have quantified changes in vertical migration due to flow fluctuations (Saha & Layzer 2008, DiMaio & Corkum 1997). This phase of the study will likely take two field seasons in order to maximize the number of behavioral observations so that any trends can be identified and evaluated. This proposed methodology corresponds to Objective 4.

At these same sites, an evaluation of flow fluctuations on dwarf wedgemussel habitat persistence should be conducted following methods similar to those of Maloney et. al. (2012). This will include the development of a two-dimensional hydrodynamic model based on modeled depth, velocity, Froude number, shear velocity, and shear stress. This model will be used to quantify suitable dwarf wedgemussel habitat and its persistence over a range of flows, including flows typically experienced under peaking operations. These methods are being employed to evaluate persistence of dwarf wedgemussel habitat on the Delaware (Maloney et. al. 2012) and Susquehanna (T. Moberg, The Nature Conservancy, personal communication) rivers. Depending on how many plots are chosen, this phase of the study could take one or two field seasons. This proposed methodology corresponds to Objective 5.

Level of Effort and Cost

§5.9(b)(7) – *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

The cost for collecting the data for this study is entirely dependent on the number of study sites selected, as well as how frequently surveys will be conducted as part of the long-term monitoring plan. The expected level of effort and anticipated costs will be comparable to that of similar FERC relicensing projects of this size.

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Requested Study 6: Project Effects on Populations of Tessellated Darter, *Etheostoma olmstedi*

Projects: Wilder (FERC No. 1892-026), Bellows Falls (FERC No. 1855-045) and Vernon (FERC No. 1904-073) hydroelectric projects

Goals and Objectives

§5.9(b)(1) – *Describe the goals and objectives of each study proposal and the information to be obtained*.

The goal of this study is to evaluate the effects of project operations on populations of tessellated darter (*Etheostoma olmstedi*), a New Hampshire species of greatest conservation concern and known host species for the federally-endangered dwarf wedgemussel (*Alasmidonta heterodon*). The specific objectives of the study are to:

1. Determine the distribution and abundance of tessellated darter within project-affected areas; and

2. Determine the effects of project operations on the distribution and abundance of tessellated darter.

Relevant Resource Management Goals and Public Interest Considerations

§5.9(b)(2) – *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied*

Not applicable.

§5.9(b)(3) – *If the requestor is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.*

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a given project is located. In making its license decision, the Commission must equally consider the environmental, recreational, fish and wildlife, and other non-developmental values of a project, as well as power and developmental values.

The mission of The Nature Conservancy is to conserve the lands and waters on which all life depends. We have over 30,000 members in the Connecticut River Basin and have assisted in the protection of 350,000 acres in the watershed, currently managing approximately 13 preserves. Through the relicensing process, the Conservancy will seek solutions that will restore natural patterns of the Connecticut River's flow regime to support floodplain forests, riparian invertebrates, freshwater mussels, and resident and migratory fish. Because of its importance as a host species for the federally-endangered dwarf wedgemussel, the tessellated is of particular interest to the Conservancy. By understanding project effects on this species, we will begin to understand more about the patterns of flow that are necessary to support dwarf wedgemussel and the river ecosystem as a whole. Therefore, ensuring that project effects on tessellated darter are considered in a reasoned way is relevant to the Commission's public interest determination.

Existing Information and Need for Additional Information

§5.9(b)(4) – *Describe the existing information concerning the subject of the study proposal, and the need for additional information.*

In the Preliminary Application Documents (PADs) for the Wilder, Bellows Falls, and Vernon projects, the applicant acknowledges that tessellated darter is one of the confirmed hosts of dwarf wedgemussel. It also identifies the occurrence of tessellated darter both upstream and downstream of each project. However, studies that specifically target small-bodied benthic species are lacking in project-affected areas. It is therefore likely that results of previous investigations are biased and underestimate true population size. An effective evaluation of project effects on a population will require robust, unbiased estimates of population parameters such as abundance or occupancy and similar estimates of population parameters under known conditions of low to no effect.

Existing literature indicates that tessellated darters may be found in a variety of habitats (Scott and Crossman 1979, Van Snik Gray and Stauffer 1999, Hartel 2002, Van Snik Gray et al. 2005, Henry and Grossman 2008), but these habitats are not necessarily equal in their ability to support the population or its function as host to dwarf wedgemussel. We cannot be certain that habitat use infers preference, nor that habitat use will be consistent from basin to basin. Therefore, habitat use within project-affected areas should be evaluated, and should be evaluated in concert with population parameters. By estimating population parameters (e.g., abundance, occupancy, extinction/colonization) as functions of habitat, we may determine whether habitat contributes to any differences in populations and if so, what specific habitat is preferred for stable and persistent populations.

Project Nexus

§5.9(b)(5) – *Explain any nexus between project operations and effects (direct, indirect, or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.*

Operations at the Wilder, Bellows Falls, and Vernon projects alter natural river flow and consequently cause changes in the availability of instream habitat on which the tessellated darter and other lotic species depend. Habitat for tessellated darters is directly related to project operations in terms of flow (water depth and velocity, and their timing, duration, frequency, and rate of change) as well as the interactions of flow with other habitat variables such as substrata, vegetation, and cover. Operations both upstream (changes to the reservoir) and downstream (changes to the flow regime) may affect habitat, and may consequently lead to changes in the distribution, abundance, and behavior of tessellated darters that could in turn potentially affect the federally-endangered dwarf wedge mussel, for which the tessellated darter is a host species.

The information collected for this requested study will help determine whether project operations have a substantial effect on populations of tessellated darter, or whether population parameters are consistent with those of other populations in the region. If there is an effect of project operations on darter populations, study results will also permit identification of those habitat components related to operations that are most important for maintenance of stable and persistent populations of tessellated darter. This will in turn provide information that will assist the development of recommendations aimed to maintain populations of dwarf wedgemussel.

Proposed Methodology

§5.9(b)(6) – *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.*

Using an accepted and robust field sampling design (e.g., as described in Pollock et al. 2002 or MacKenzie et al. 2006) and accepted methods for collecting tessellated darters and other similar small-bodied fishes, conduct a field survey for tessellated darters within all project-affected areas from the headwaters of the Wilder pool downstream to the Vernon dam, as well as in selected areas outside of the project-affected areas with known stable populations of tessellated darter and/or dwarf wedgemussel. Such a sampling design should include replicate samples for estimation of species detection probability. For each replicate sample, collect and record data that may be important for describing differences in populations of tessellated darter, such as presence or abundance of other species (e.g., dwarf wedgemussel, slimy sculpin *Cottus cognatus*), depth, velocity, water temperature, substrata, time of day, presence of cover, proportion of vegetation cover, size of individuals collected (juveniles may select different habitat; larger individuals may outcompete smaller individuals for preferred habitat), and other factors as determined by a qualified biologist. Include also as covariates any relevant flow characteristics (Zimmerman 2006) that may differ among sites.

Using methods as described by Kery et al. (2005), MacKenzie et al. (2006), or Wenger and Freeman (2008), determine whether population estimates of tessellated darter are different in project-affected areas and, if so, which measured factors or flow characteristics are most important in describing these differences.

Prepare a report or provide supplemental material that includes:
- the specific location (coordinates) of each site and date /time of each sample;
- the measures of habitat variables that are collected at each site and for each sample;
- the identity and length of each individual fish collected, including fish species that co-occur with tessellated darter;
- documentation of any mussel species that are encountered at each site and in each sample;
- photos of representative specimens of each collected species;
- description of flow characteristics included in the analysis;

- estimates of species detection probability;
- estimates of species occurrence probability;
- estimates of species abundance, and
- tables of model selection results.

Level of Effort and Cost

§5.9(b)(7) – *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

The cost for collecting the data for this study is entirely dependent on the number of sites, number of sample replicates, and the extent of the covariate data that are measured, all of which should be determined during the development of the study plan in consultation with fishery agencies and other parties, and may be adjusted during the course of field sampling. In general, if a species is common and easily captured, few replicates and many sites produce the best estimates, whereas more replicates and fewer sites are preferable for rare species. In general, the more replicates added, the lower the errors in detection probability, and the more sites sampled, the lower the errors in population parameters. The number of people required in the field will be dependent on the sampling method that is selected, but should be at least two individuals. Provided the collected data are of high quality, analysis and synthesis should take at most 5-10 days.

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CONCLUSION

Thank you for this opportunity to provide comment on the Commission's Scoping Document 1 and offer study requests for the license renewal of the Wilder, Bellows Falls, Vernon, Turners Falls, and Northfield Mountain Pumped Storage hydroelectric projects.

If you have any questions regarding the comments or study requests herein, please contact Katie Kennedy at the Nature Conservancy's Connecticut River Program office (413-586-2349 or kkennedy@tnc.org).

Respectfully submitted,

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February 28, 2013

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Office of Energy Projects
Division of Hydropower Licensing
Washington, DC 20426

RE: Wilder Dam Project No. 1892-026
Bellows Falls Project No. 1855-045
Vernon Project No. 1904-073
Turners Falls Project No. 1889-081
Northfield Mountain Pump Storage Project No. 2485-063

Dear Mr. Hogan,

The Nolumbeka Project Inc., wishes to establish a line of communication between your office and our organization as you move forward in re-licensing the five hydroelectric projects along the middle Connecticut River in the states of Vermont, New Hampshire, and Massachusetts.

The Nolumbeka Project is a Massachusetts based 501 (c) (3) non-profit corporation whose preservation mission includes the promotion of a deeper, broader, and more accurate depiction of the history and culture of the Native Americans of New England. Our organization holds the deed in preservation of a forty-one (41) acre ancient Indian village and sacred site called Wissatinnewag on the Connecticut River just down stream of the Turners Falls Dam. This twelve thousand year old village is part of a much larger complex that make up what archaeological studies have revealed to be one of the most significant and culturally diversified Native American gathering places on the banks of the Connecticut River. We are currently partners with U.S. Fish and Wildlife Service with their twenty-two (22) acres in our preservation efforts for a combined sixty-three (63) acre historically important piece of property that abuts the Connecticut River on the west bank, running north to south from the confluence of the Falls River, just below the Great Falls (Turners Falls) and down stream a distance. The village itself was a larger complex that runs further south down stream to what is now referred to as Rock Dam. The Wissatinnewag Village site is located on the border of Gill and Greenfield Massachusetts, across the river from the village of Turners Falls, in the Town of Montague.

The history of this area and our site is much too complex to go into detail in this letter, but if given the opportunity to provide information to your office and the public, I am certain that it will become clear just how important this stretch of river was in the history of the indigenous people going back over twelve thousand years. Our website does offer more detailed information. Go to www.nolumbekaproject.org

The story that lies here in this land and on this river has never been fully and accurately told for many reasons, mostly political and cultural. The last time the hydro projects were up for licensing and re-licensing there existed all across the country, and most especially here in the Northeast, an indifferent attitude toward old Indian sites and burial places. That attitude proved to be devastating to the Native American cultural resources here on the river and elsewhere. However in 2011, members of our organization had the opportunity to monitor the work on an electrical power grid infrastructure upgrade in the town of Leverett, Massachusetts. The challenge on that project was to bring heavy equipment on to the site without damaging the ceremonial stone structures identified there. The level of cooperation and respect we experienced on that project to preserve the ceremonial stone landscape in the project area proved to us there has been a change of attitude from the utilities about historic cultural preservation, and we look forward to this new level of dialogue and respect.

In relation to conducting field studies, it should be known that archaeological training processes used by most universities and public organizations are woefully lacking on the subtle cultural understanding of the lifestyles and social practices of the indigenous peoples of the Northeast. Our organization feels it is of paramount importance that this work be done and supervised by people with the proper training and understanding of how to read the land and to recognize the lifestyle and sacred practices and spaces of the indigenous peoples that existed on this stretch of river. The data from this study needs to be digitized into a format that will make it accessible for use by the appropriate researchers and Tribal Historic Preservation Offices (THPO’s). The Nolumbeka Project, as the first indigenous people’s cultural preservation organization in the region has taken on this challenge and seeks a role as a lead organization for future researchers, historians and government agencies.

The impact the past and current hydro projects have had on the very ancient relationship that played out with the water’s edge, the land, fish, animal and human interactions on the Wissatinnewag site as well as other places on the river, has been forever changed, and with it a chance to see and better understand what was here, when, and why the indigenous people from many different tribal cultures journeyed here by the thousands each spring, and stayed throughout the summer to fish and grow crops.

A cultural gathering place that was a melting pot of intertribal activities encompassing social, spiritual and technological exchanges, and a connecting point, “the hub of the wheel”, that brought together tribes from a radius of a thousand miles was established here. There is much we can learn about what that looked like on a seasonal and more importantly on a daily basis, but most of the archaeological studies and dig information for the Riverside Archaeological District and other places on the river and elsewhere in our area, have been inaccessible for decades, and in most cases have been classified as highly restricted. Our organization has been repeatedly denied access to that information. That old system of restricting access to classified research data to protect archaeological resources, has had the opposite effect, and has failed to communicate to the public and the resource managers, the story of the Indian People and the land in a way that could have protected many of the unique and irreplaceable cultural assets we witnessed destroyed on the Wissatinnewag property that is now in our stewardship. This has also been true for many other sites on the river and elsewhere.

It is our sincere hope that the time has arrived for organizations like ours to experience a more balanced, and equity driven working relationship with the FERC, the utilities, the public, the Massachusetts Historic Commission and other governmental agencies.

We are seeking to bring into balance the historical and cultural gaps and losses of natural habitat and cultural resources that were experienced on this stretch of river during the time of past re-licensing issuances. To do this, we will lay out our request for five project studies for consideration at this time that we feel will contribute to the usefulness of the yet untapped historical project resources under consideration.

Study request 1

We are requesting a comprehensive investigation and mapping of the many ancient traversing trail systems and fishing stations as well as village locus and other special places that still exist all along the river’s edge and up on the land of the Wissatinnewag village, as well as south down river to and beyond the area now known as Rock Dam. The northern section of this area is currently listed in the National Register of Historic Places as part of The Riverside Archaeological District. Our goal is to identify and recognize the hidden historical and cultural value in this land that will foster a stronger awareness and level of protection from the many poor development choices we experienced in the past and see on the horizon.

Part two of request 1

We are requesting to do additional comprehensive investigations, documents searches and other research and field studies and inventory and formal archaeological digs, to address the project areas north up to and around the Wilder and Vernon Falls (dam) on the New Hampshire, Vermont, and Massachusetts sides of the river. Any time there are obstructions on the river, like a falls, we understand that a fishing site and a village would have been a part of the landscape. This is where fish are held and create fishing opportunities. These areas hold a wealth of archaeological information that needs to be taken into account when projects are undertaken on the river’s edge, or on infrastructure upgrades that are made inland of the project area and might cause the loss of those cultural assets. The Nolumbeka Project, Inc. sees the access to background literature reviews of previous cultural resources and archaeological study reports, and the development of archaeological sensitivity models and focused field reconnaissance studies, which include access to the existing archaeological study data in the files of the Vermont, New Hampshire, and the Massachusetts, State, corporate and other NGO archives, as an important component for use in our historical archive research library. This would add a centralized and accessible body of knowledge for use in determining the cultural assets at risk in the project scope area.

Because of the current disconnect to the past cultural data, and lax attitude of past project's responsibility to that data, we see a need to organize that data in a central location and make it digitally available. At this point in the conversation, without knowing all the parties who would need or want to be involved, it would be nearly impossible to do a cost projection for this request.

Study request 2

We request that a comprehensive field survey of wildlife and botanical species/habitat to identify, catalogue, digitize, and show the association and use of the many indigenous plant species, both protected, and unprotected, that played a part in the cultural lifestyles of the people who used them. This information would prove to be useful for endangered species protection and life ways studies of the ancient river tribes. The cost of this process would be determined by the number of sites that give indication of Native land use in the projects areas, and that has yet to be fully determined.

Study request 3

We request a project be undertaken to stabilize the exposed sand bank and protect from erosion damages other disturbed areas on the Wissatinnewag property damaged during mining and contracting work or the result of storm damage experienced prior to the acquisition of the land by The Nolumbeka Project. The goal would be to return the site to a green-fields condition for use as a cultural educational resource. This should include planting of indigenous grasses and plants known to have existed here prior to the land being disturbed. In addition, this would allow an experienced team of botanists, historians and archaeologists to do the basic research to develop a more complete cultural profile on the Wissatinnewag site and other important sites on the river in the resource areas under the license obligations from the utilities. The cost for this process would be impacted by the results of the second study request, which we do not have at this time.

Study request 4

We request a project be undertaken to identify and implement the formation of a National Historic Park around the Great Falls fight site in the Gill and Turners Falls area. A Historic Educational Park and self guided hiking trails, would allow the story of the May 19, 1676 attack on the refugee camp at the Wissatinnewag and the Peskeompskut village sites to be told from the indigenous point of view, and would help to educate and celebrate the importance of the relationship The Great Falls played in the lives of the indigenous people, who for over 200 generations, considered it to be a village of peace and place of cultural and technical exchange and celebration. This educational experience fits right into the Town of Montague's efforts to establish the River Culture and history of the Great Falls as a destination for historical tourism. The Town of Northfield is also talking about historic tourism as part of their new Master Plan. As part of this process we would like to also request a central housing facility in the Gill or Turners Falls area for our historic archives and study programs. Researchers, educators, and THPO's across the northeast and beyond could use this office. It could also be a central location for preservation efforts here in Western Massachusetts. A study needs to be done first to arrive at the cost of this project. An office location for the Nolumbeka Project might be incorporated into a River Culture complex with the Town of Montague and other NGO's, to offset the expense of the project.

Study request 5

In the early sixties a construction company mined the northern portion of the Wissatinnewag Village area we are responsible for preserving. During that time period sand and gravel from the Wissatinnewag Village site was taken for the building of Route 2 in Greenfield across the street and Route 10 in the Northfield area. During this phase of history on the site, part of the village was destroyed and untold numbers of unmarked burials were displaced. Sadly, human remains mixed in the sand and gravel often became part of the road base for the Route 2 and Route 10 road construction projects at that time. The construction company used the mined out portion of the village to deposit and bury construction debris. Old tires, discarded construction materials and steel barrels were buried there. That portion of the village leaches into Falls Brook, which goes into the Falls River and within a few hundred feet into the Connecticut River. We would like to clean up the pollution going into Falls Brook and restore the area to a clean and healthy ecosystem. Addressing this challenge would make the area safer and more useful in our educational and preservation programs on the site. The cost of this effort could only be determined by testing for the extent of the contamination on the site impacted, and that has yet to be done

From the Board of The Nolumbeka Project and myself, we would like to thank you for the opportunity to be a part of this process, and we look forward to a rewarding and productive exchange and working relationship on this re-licensing project.

Sincerely,

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Relicensing Project Manager
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4 Park Street, Suite 402
Concord, NH 03301

Re FERC Project 1892

Dear Mr. Ragonese,

I am the owner of a 14 acre± field with Connecticut River frontage in New Hampshire just north of the bridge that crosses from Lyme to East Thetford, Vermont. I will attend the public scoping meeting in West Lebanon, NH on Monday evening, January 28th 2013 in order to comment upon water level management practices and their relationship to riverbank erosion. The Pre Application Document synopsis of studies by Simons, et al (1979), and Kleinschmidt (2011) is not based upon any quantitative measurements of erosive activity. Thus the contention by abutting landowners that daily fluctuations in water levels resulting from the project cause significant amounts of bank erosion cannot be judged true or false on the basis the information presented. The contention by those writing the Document that such daily fluctuations in river levels are not important causes of such erosion cannot be accepted in the absence of quantitative studies.

The Document does present information concerning the presence of moderate to highly erosive soils near the river. These are precisely the soils that have conferred on the Connecticut River Valley a world class rating for the agricultural potential of its soils. It is these qualities that have induced farmers to farm it, and before they can be tagged with major blame for riverbank erosion better information than that in the Pre Application Document is required

A competent study should be designed and conducted that addresses the effects of water level changes on erosion and siltation around the Wilder Pool. Without going into various methodologies that could be employed to develop the answers, I will simply list several questions the study should answer:

1. What is the rate and amount of dewatering per unit of selected riverbank soils that occurs when the river level falls?
2. What, if any, relationship exists between the amount of drop and amount of dewatering?

3. How does dewatering relate to the *rate* of fall in the water level and to the duration of a raised water level.
4. How much soil is removed by dewatering per unit of soil and what is its distribution subsequently as a result of a given amount and rate of dewatering?
5. On the basis of these studies an estimate of siltation from the Wilder Lake source will be possible. It can then be compared with siltation as a result of input from upstream dams, and that arising from the four main and smaller tributaries in the intermediate drainage area above Wilder. When coupled with information concerning silt passed by Wilder to the river below the dam, an estimate of the useful lifetime of the Wilder Pool will be possible, and can be compared with other methods of estimating its useful life.

One might have imagined that at least we would already have the results of slump tests on various soil types at different water level exposures. Even these have not been done.

Once completed, a well-done study will allow allocation of the sources of siltation of the Wilder Lake, a matter of concern to the operators of the Project as well as to the community in which the Project is based. Quantitative information may suggest improved strategies for water level manipulation that will diminish erosion of the riverbank.

The benefits of hydropower are increasingly important as renewable energy becomes a national priority. The value of the Project to the operators as well as to the community will best be served by insuring that the useful life of the project is not compromised by a preventable loss of reservoir capacity.

On page 3-14 the statement is made that "*The project is operated in a daily cycle "run of the river" mode where daily inflow matches daily outflow. This may result in modest daily pond fluctuations due to upstream Project-related generation, mainly at the downstream end of the Wilder Reservoir due to the "pitch" of the river, but relatively constant water levels are maintained.*" I paddled my canoe on the Connecticut River in 1949, prior to the closure of the Wilder dam, and I find this statement outrageous. Current Wilder Lake levels are not a run of the river situation, and it is fortunate for the applicant to be able to blame the upstream dams if it isn't. A rise or fall of one or two feet during a single day prior to the presence of dams on the river would have signified a major meteorological event. The words "relatively constant" used to denote changes of a foot or more in water level in 24 hours could only be used by a person wishing to obfuscate the effects of water level changes and the statement should be removed from the Document. No unbiased person walking the river bank on even an occasional basis could agree that the river levels are "relatively constant".

Conclusions: The Pre Application Document references work by consultants who have offered the opinion that changes in water levels in the Wilder Lake are not important causes of riverbank erosion. This opinion is not supported by any quantitative study. Some of the abutters of Wilder Lake believe that fluctuations in water levels in Wilder Lake are largely responsible for erosion of the shoreline. They have not offered any quantitative information to support their opinion. It is in the interest of the operator of Wilder Dam, the abutters to the Project and to the public at large to have a means of allocating responsibility for erosion and the resulting siltation of the reservoir. If the suggested study shows that such erosion is a substantial component of siltation it is in the interest of the public for the Regulators to take reasonable steps that could diminish it and to allocate responsibility and costs for such steps.

The words "relatively constant" used to denote changes of a foot or more in the Wilder Lake water level in 24 hours should be deleted from the Pre Application Document.

Please inform me if clarification on any points I raise above is necessary and I will be pleased to respond.

Sincerely yours,

O. Ross McIntyre, M.D.

Document Content(s)

Study Plan, 18CFR Section 5.9b
Submitted for the Wilder Project, FERC 1892-026

By The Town of Lyme, New Hampshire
Office of the Selectboard
Box 126
Lyme, NH 03768
lyme@lymenh.gov

and
By the City of Lebanon, New Hampshire
City Manager
51 North Park Street,
Lebanon, New Hampshire 03766

and by an abutter to the Wilder Dam impoundment

O. Ross McIntyre
34 Lamphire Hill Lane
Lyme, NH 03768
603-795-2624
o.ross.mcintyre924@gmail.com

Dated February 26, 2013

Table of Contents: Page

Goals and Objectives:

The goal of the proposed study is to obtain data concerning piping erosion at the shoreline of the Wilder Dam impoundment and to ascertain whether erosion may be reduced by changes in water level management practices by the dam operator. The study will

1. Identify the effects of the size and rate of river level changes on water transport into soils surrounding the impoundment.
2. Study sites will include known highly erodible soils as well as less easily eroded soils.
3. Study sites will also include locations where bank stabilization using various methods has been performed.
4. Identify sites where piping erosion occurs and estimate the amount of siltation from such sites.
5. Place river level and flow gauges at selected study sites above Wilder Dam.
6. Record and collect measurements of flow and river levels at these gauges and Wilder Dam.
7. Produce a model for the management of water levels and rate of water level change that will reduce erosion.
8. Allow the effectiveness of bank stabilization methods to be tested

The strategy is to examine the rate and size of water level changes in the reservoir to ascertain whether these variables produce significant changes in the amount or rate of water loading of erodible soils. This information would enable management of river levels that reduce siltation without necessarily compromising the operator's goal to achieve a satisfactory return on its investment.

The study Objective is to gather data on erosive activity and river flows that will assist the operators of the Wilder Dam and FERC in developing a management plan that minimizes erosion. Reducing erosion, in turn, meets several objectives of public importance:

1. improvement of water quality in the reservoir and downstream
2. improvement in the scenic and recreational value of the river
3. preservation of valuable agricultural land – a resource for migrating birds and wildlife
4. reduction in the siltation in the reservoir with resulting loss of storage capacity and dam lifespan
5. increased protection for private and governmental shoreline structures and/or infrastructure

Relevant Resource Management Goals

5.9(b)(2) Not relevant

5.9(b)(3) Sections 4(c) and 10(a) of the FPA require the Commission to give equal consideration to all uses of the waterway on which the project is located. When reviewing a proposed action the Commission must consider the environmental, recreational, fish and wildlife, and other non-developmental values of the project as well as power and developmental values.

Public Interest Considerations

All of the objectives listed in the Study Objective section on page 3, points 1-5, comprise issues that are in the public interest and which the Commission must consider in addition to power generation and development.

Existing Information and Need for Additional Information

Members of the public speaking at the Scoping Meeting in West Lebanon on January 28th[th], 2013 presented anecdotal evidence of erosion their properties abutting the Wilder impoundment. They claimed that the rate of erosion had increased recently, and corresponded to the changes in management of the project following assumption of operations by TransCanada. A popular belief amongst those commenting on this subject is that when water levels are raised, water flows into the soil in the river bank, and when the water levels fall this water flows out of the bank, and carries with it soil particles such that, over time, the bank is undercut by this process.

This is certainly not the first time that concerns about erosion related to this project have been raised. At the time of the last license renewal for the project, the issue was the subject of a study performed by the Army Corps of Engineers the results of which are reported in a synopsis in the PAD prepared for the current license renewal. (Simons, D.B., Andrews, J.W., Li, R.M., and Alawady, M.A. 1979. Connecticut River Streambank Erosion Study Massachusetts, New Hampshire, and Vermont. Prepared for USACE, New England Division.

I quote the synopsis of the Simons, et al. study that appears in the Pre Application Document (PAD):

"The Wilder impoundment was evaluated in this study, which discussed the various processes that occur along the Connecticut River. The study emphasized two categories of forces that affect the shoreline: (1) those forces that act on or near the surface of the

water associated with pool fluctuations; related piping; groundwater; wind waves; boat waves; ice; lack of, or removal of, vegetation;

The forces that act at or near the surface of the water generally cause the bank to gradually adjust by developing a bench or berm area wide enough to dissipate the forces causing erosion, increasing upper bank stability as the adjustment occurs. The report includes an estimate that the extent of erosion landward would in most cases be limited to an average of about 10 to 15 feet in a large river (such as the Connecticut River). After the bench is formed, growth of aquatic vegetation usually takes place, further increasing the stability and curtailing further significant upper bank erosion."

It should be noted that this study mentions "pool fluctuations and related piping," and the reader might conclude that this process as well as others, will be responsive to the riverbank remodeling process. In summary, the authors of this study offer an optimistic view that when the bank remodeling process is complete that erosive forces will be dissipated and a more or less steady state will then prevail.

The remarks by numerous property owners concerning ongoing erosion of their properties at the time of the Scoping Meeting on January 28th, 2012, is evidence that the sequential changes described in the Simons study have not occurred or, if they have, have not operated to control erosion. Although Simons mentions pool fluctuations and piping, the same process the property owners contend is responsible for erosion of their land, pool fluctuations and piping fails to appear as a significant cause of erosion in the PAD.

Piping: Since the above study was performed the issue of "piping" has received a great deal of attention by geomorphologists and hydraulic engineers, because of the risks that erosive piping confers on earth-filled dams and levees. In situations where hydrostatic pressure is exerted one a side of the dam or levee and the soils used in the construction of the structure do not offer a uniform and effective barrier to water penetration, avenues of permeable soils left within it, transmit flow to the low pressure side. This flow carries away soil particles at the low pressure end of the affected strata often leading to a tube-shaped cavity propagated inward from the low pressure side, and referred to as a "pipe." Erosion continues back up the path of water flow (backward piping) until the process reaches the high pressure face of the barrier, often with catastrophic results for the structure.

The same process operates in river banks, though usually with less dramatic outcomes. Fluctuations in river levels may cause permeable soils to accumulate water during high water and when the river level falls, the water trapped in the permeable soil exits carrying soil with it. The formation of tunnels or caves, sometimes of considerable size, with subsequent collapse of overlying strata, at times many feet from the bank, to produce a "sink hole" is one result of this process. At other times the process affects soils closer to the river bank and causes collapse of a portion of the bank into the river.

The term, "sapping" often used in conjuction with descriptions of piping, refers to the erosion caused by groundwater from sources such as springs in a river bank that carry soil away with resultant undermining the bank.

The 1992 report prepared by D.J. Hagerty from the Civil Engineering Department of the University of Louisville for the U.S. Army Corps of Engineers (ACE), (Identification of Piping and Sapping Erosion of Streambanks (Contract Report HL-92-1) is a definitive examination of this phenomenon. It employs observational methods to identify piping and to separate it from other types of erosive activity. It also addresses methods for prevention and mitigation of such erosion.

In a 1991 article in the the Journal of Hydraulic Engineering, Hagerty used knowledge derived from work leading to the above report to comment upon the subject more generally. (Hagerty, D. (1991) "Piping/Sapping Erosion. I: Basic Considerations." J. Hydraul. Eng. 117(8), 991-1008.

I quote a portion of the abstract from this article: *"This mechanism is widespread in occurrence and is very significant to bank and shore stability, but is* ***rarely*** *recognized.* [emphasis mine]. *The mechanism is complex and acts in concert with other processes of bank and shore erosion and deposition. Operation of those other mechanisms often masks the processes and products of the piping/sapping mechanism. Furthermore,* ***failures caused by this mechanism may occur during periods of stream inactivity long after storm and/or flood events have ended****.* [emphasis mine]

In anticipation of the reapplication for the relicense TransCanada commissioned a new study of erosion sites currently present on the Wilder impoundment by Kleinschmidt (Kleinschmidt Associates, Inc. 2012. Technical Report – Phase 1A Archeological Reconnaissance Survey, Wilder Hydroelectric Project (FERC No. 1892). Windsor and Orange Counties, Vermont and Grafton County, New Hampshire. Pawtucket, Rhode Island, July 2012.

Kleinschmidt's shoreline surveys in 2010 found "*moderate to severe erosion along sections of the shoreline upstream of Wilder Dam…."* and attributed this to *"rapid decline of stream inflow following a prolonged or sustained high inflow period where bank-full flows combined with surface runoff flow result in high saturation of low cohesion bank material."* The report continues with an examination of farming practices and comments on how agricultural practice has culminated in the lack of adequate vegetated buffer in 77 of 100 erosion sites studied.

As a result of the studies by Simons and Kleinschmidt TransCanada states in Section 3.4.6 of the PAD that it "*knows of no information suggesting that the Project or its operations are solely responsible for any adverse effects on geological or soil resources in the vicinity of the project. As indicated in section 3.4.5, Project operations associated with impoundment fluctuations play a minor role in shoreline erosion, with flood flows from major storms playing a significant role. Other causes of erosion, including agricultural practices, piping, groundwater, wind waves, boat waves, ice and lack of or removal of vegetation also play roles in ongoing erosion effects on geological and soil resources."*

Neither of the two studies reported in the PAD attempt to quantify the erosion due to piping. Kleinschmidt's statement that the major cause of erosion, "*rapid decline of* *stream inflow following a prolonged or sustained high inflow period…"* describes the essential characteristics of a piping situation without reporting on the ground or bank observations that could confirm the operation of this mechanism in the erosive events. Nor did either of the two studies described in the PAD attempt to ascertain whether impoundment fluctuations caused by the Project result in piping erosion. TransCanada did not recruit a person with extensive experience in the recognition of piping erosion for the conduct of the studies despite hosting a situation in which the piping mechanism of erosion is most likely to be operative and in situations in which experts in the discipline describe it as being most likely to be overlooked. For this reason the **statements in section 3.4.6 of the PAD should be disregarded in the relicensing process**, because the applicant's studies were not designed or conducted in a manner capable of ascertaining whether piping erosion was resulting from reservoir fluctuations.

Further, there is an extensive literature concerning mechanisms for mitigating piping erosion. Some of these are laboratory based, for instance Fox, GA, Ma Librada Chu-Agor,M,and Wilson,GV; SSSAJ 71 No6 p1822-1830, 2007 and Tomlinson,SS, and Vaid YP; Canadian Geochemical Jr. 37(1); 1-13,2000 while the NSF has awarded a grant for investigation of groundwater contributions to the piping process to support research at the Oklahoma State University and the USDA-ARS National Sedimentation Laboratory in Oxford Mississippi. (Fox G, Wilson GV; Resource 19 (2) 15, 2012). These investigators are using methods that could be applied in the case of the Wilder impoundment.

Other methods of mitigation are field based (summarized in Hagerty, referenced above). Essentially, successful mitigation includes establishment of a barrier to water infiltration in the subject area coupled with appropriate steps to maintain that barrier intact. **While maintenance of stream-side vegetated buffer zones is desirable for many reasons, such zones do not prevent piping in highly erodible soils such as are found in farmland surrounding the Wilder impoundment.** For example, substantial erosion in a mature **natural** area referred to as "Pine Park" in Hanover was reported by a member of the public at the Scoping Meeting held January 28thth and 23 of the 100 examples of erosion reported by Kleinschmidt (above) occurred in non-agricultural sites. **Nor does formation of a berm of collapsed bank material necessarily prevent subsequent water infiltration of porous soils and continuance of the piping erosion mechanism.**

Examples of Damage to Infrastructure by Erosion:

River Road North:

In 2011 a large section of the bank adjacent to the western side of River Road in Lyme, just south of the North Thetford road, collapsed into the Wilder impoundment. Because of this, 1200 feeet of River Road had to be reconstructed. This road passes through Lyme and other New Hampshire river towns and was the route to Canada in colonial times. Very little rerouting has occurred, and for the most part, the road follows the same path as it did more than 250 years ago. The section of road that had to be reconstructed passes between the river and houses built around the time of the signing of the Declaration of

Independence. Until 2011, the road was able to defy the record floods and ice jams to which it was subjected.

Figure 1. Collapse of a portion of Wilder impoundment bank in spring of 2011 necessitating reconstruction of 1200 feet of River Road south of its intersection with the North Thetford Road in Lyme , New Hampshire.

Figure 2 River Road north adjacent to bank collapse. Note pattern of cracks in blacktop and compare with those in photo 3, below, in area of slumping River Road South.

The engineering report prepared by HTE Northeast, Inc. states that the cause of the bank collapse was long-term erosion and undermining due to flow action, and existence of water in the riverbank soils. Piping was not a named cause although the statements concerning water in the riverbank soils is consistent with that mechanism. The report also states, **"The frequent raising and lowering of the water level by downstream dam management (Wilder Dam), over time, is a contributing factor."**

In order to repair the road, it was moved east because of the excessive cost of reconstructing it in situ. The farmland to the east of the road was the subject of a conservation easement. Because of the protection of farmland conferred by the easement, it was necessary to take the land by eminent domain. Following this, the road was rebuilt according to an engineering plan that fails to mention piping and may not have used impervious material to mitigate erosive piping in the future. The total cost of the project was $685,308 of which the Town paid $398,061. The remaining $287,247 was paid by a grant from the U.S. Department of Agriculture (NRCS). Because of regulatory and financing requirements related to the repair, the road was closed to travel for nearly 2 years.

River Road South:

River Road a quarter mile south of the East Thetford Bridge ascends to a bench that runs along farm and woodland to the east. On the west a steep bank descends to the river below. In this section 120 feet of the western half of this road has settled, with a more pronounced dip of 30 feet as shown in figure 3 below.

Figure 3. River Road, Lyme, looking south about a quarter mile south of the East Thetford bridge. The string is on the road at each end of the slump which is 7 inches below the string in the center. Note the cracking of the blacktop on the west side of the road due to the slump and compare it with the cracking seen in the photo taken at the site of the collapse near the North Thetford road in figure 2

.

Figure 4. River road south looking west. Wilder impoundment in background. Slump in road is 7 inches.

Additional observations on River Road: Immediately north of the section shown in Figure 1 and 2, another several hundred feet of River road is threatened by erosion and is subject to collapse. **A survey of the rest of the road by the Lyme Roads Committee documents additional segments constituting about a mile in total that are in danger.**

Conclusions: Erosion due to piping may be difficult to detect in situations where there are other causes of erosion at work. It is more common than generally recognized and can result in bank collapse and sink hole appearance long after high water has receded. Such erosion may be recognized later when it occurs under paved roads than in farm fields where observations are easier. Piping may be anticipated when porous soils are exposed to fluctuating water levels as encountered in dam impoundments. Erosion due to piping is clearly present in agricultural land surrounding the Wilder impoundment and this piping may also have been an important factor in damage to River Road in Lyme. Members of the public commenting at the Scoping meeting on Monday, January 28th, 2013 stated their belief that erosion had increased subsequent to the assumption of dam management by TransCanada. It should be determined whether this is true and if so, how important water level fluctuations in the Wilder Impoundment are to the piping erosion events mentioned above.

Project Nexus

Connection between the project and its potential effect on the applicable resource.

The application for renewal of the Wilder Dam license intersects with an assortment of resources, including clean water, preservation of riverine habitat, aquatic recreation, and public safety among others.

The applicant recognizes this, and presents in the PAD the results of two studies that address the subject of erosion in the Wilder Dam project area. These two studies have led the applicant to conclude that Project activities have a minimal impact on the above listed resources. (See section 3.4.6 of the PAD and cited above.) It is up to FERC to decide whether the studies the applicant has already performed allow TransCanada to reach the conclusions that are offered in section 3.4.6 of the PAD without further evidence to back those conclusions. **The Existing Information section, above, provides abundant evidence that TransCanada cannot conclude that the dam operation has no significant effect on erosive activity.**

How the information from this study would be used to develop license requirements:

The study will test the hypothesis that the rate and amount of impoundment water level changes correlate with the amount of piping erosion. The study will also determine whether piping erosion is an important component of overall erosion in the Project. If the hypothesis is proved true and if piping constitutes a significant portion of the erosion taking place, then the license could set rate and amount of change limits in the Wilder impoundment that would reduce erosive damage. In addition, the license could require the Applicant to mitigate such erosion, especially with respect to damage to infrastructure and agriculture.

Proposed Methodology

Introduction: Currently, the most used method for the investigation of piping erosion is that of observational field studies by those with a large amount of experience in making these observations. Because the results are provided in a descriptive rather than quantitative sense, they can be challenged, but only successfully by those with quantitative data. As will be seen below, the observational studies have the advantage of the least cost, but lack the persuasive value of numeric data. At the other end of the methodologic spectrum are quantitative tests that could yield reasonably accurate measurements of unit losses due to erosion. Perhaps the most sophisticated of these is based upon isotope dilution techniques using residual tracer radionuclides deposited as a result of atmospheric bomb testing, coupled with soil sampling, soil mapping, water sample collections, and extensive instantaneous measurements of flow and level in the Wilder impoundment. This latter approach would require a major investment of human and material resources and have a higher cost. We have chosen to describe a methodology of intermediate complexity and cost that will yield some quantitative data and will assure feasibility for the purpose of this study request. **Nevertheless, any study of piping required by FERC should first pass muster with consultants chosen from**

those referenced in the background section of this study proposal.

Hypotheses to be tested: 1.The rate and/or amount of water level changes in the Wilder impoundment correlate with the amount of piping erosion. 2.Piping erosion is an important component of overall erosion in the Project.

Study Design:

1. Appointment of expert panel: several experts in the field of piping erosion should participate in a site review of the geomorphology of the Wilder impoundment, soil maps, erosion locations, local resources, and operations of the Wilder Dam. This panel will specify the study sites, study calendar, type and number of gauges required, type and number of core samples required, and recommend methods to document erosion at soil pipe exits.
2. Overview of measurements to be made: At selected sites of known elevation on the impoundment, water levels and flow rates will be measured and recorded continuously. On shore, test bores will be made in a grid according to recommendations by the expert panel. Soil sample segments will be collected at various depths from the surface level to 380 feet above sea level, the lowest operating level of Wilder Dam. Cores will be obtained when the impoundment is at various water levels and times in relation to water level changes as recommended by the expert panel.
3. Data Recording: The study will yield a large data-base and the outcome of the study will depend on the accuracy and completeness of the data collected. Prior to activation of the study, the data collection methodology as well as statistical methods should be reviewed and approved by the expert panel.
4. Handling of cores: The recommendations of the expert panel will be followed concerning the handling and protection of the cores for measurement. In general, the water content at various levels and distance from the impoundment bank will be determined. The standard for this measurement will be the original weight minus the weight after oven drying to a constant weight. The experts may recommend surrogates for this cumbersome method. The budget for the project could be reduced if photographs of slump testing using an inverted cone method correlated well with the standard. Further studies may be recommended by the expert panel to characterize the properties in each soil core .
5. Bank observations: The bank face in the study areas will be evaluated and documented using methods suggested by the expert panel for evidence of outflow of water and/or silt. Insertion of dye markers into test bores showing high amounts of water may be used to identify lateral connections to the bank face.
6. Correlations with the hydraulic "history" of the impoundment/soil interface: Before data collection begins certain assumptions must be stated so that the required number of samples and observations collected can be ascertained. Some of these are given here: A. At a rise to a given high water level, porous soils at that water level will become wetter. This process will propagate inward from the impoundment/soil boundary. B. This process will be slower or non-existant in relatively impervious soils such as clay. C. When impoundment water levels drop,

dewatering of porous soils will occur. D. Such dewatering will be visible at the surface of the bank once flooded by the now receding water. E. The longer the high water level is maintained the further inward water infiltration will occur. F. The more rapid the water level in the impoundment falls the more rapidly the previously watered area will dewater. G. The more rapidly the soil is dewatered the more evidence there will be of erosion at the bank. H. These predicted changes will occur in soils tested within the strata subject to varying water levels resulting from normal operations of the Wilder Dam.

7. Before data collection begins the expert panel should agree on what level of statistical significance should be used for the various correlations sought above and others that may be relevant.
8. The study results will be in the form of correlations or lack thereof that support or deny the hypotheses stated.
9. Modeling from this data will enable estimates of the total amount of wetted area and volume subject to erosion at various water levels in the impoundment as a result of the rise and fall of the impoundment. This coupled with local observations of silt flow from piping will provide a measure of how significant the piping mechanism is to the erosion in the Project area.

Level of Effort and Cost:

As mentioned in the Study Methodology Section above, the cost of the project will depend upon the final study design. Three methods of gathering the data of progressively increasing cost were described yielding small, intermediate and large amounts of quantitative data concerning erosion. The intermediate level of study has been chosen for the purposes of cost estimation in this section of the study plan.

1. Expert panel: Three members travel, per diem and consulting fee for five days. Meet with Hydrologist and Statistician. Four days will be required to identify, map, and examine existing and possible future piping erosion sites for layout of drill core locations. One day will be required at end of data analysis period to determine results and present conclusions from the study. Travel $6000, Per diem $3000, Consulting fee: $12,000 Total $21,000
2. Field Hydrologist: meets with Expert Panel and Statistician, marks drill sites, supervises drill crew, places gauges for measurement of stream flow and depth, maintains instruments, downloads digital output from gauges and correlates with timing of drill core procurement. 80 hours. $8,000 plus instrument cost $2,000 Total $10,000
3. Statistician: Meets with Expert Panel and Hydrologist. Determines number of cores per site on basis of pilot data and record of impoundment fluctuations in order to acquire needed number of observations to deliver a valid study. Analyzes results from lab using statistical package agreed upon by Expert Panel. Supervises data manager. Consulting fee 40 hours. Total $ 4,000
4. Field Technician/data manager: Receives core from drill operators, places in pre labeled container, and delivers to lab for measurement of water content. Tabulates

data from lab. Total 120 hours $6,000

5. Truck mounted drilling rig and crew 15 days at $1900 per day plus one time positioning and setup fee $500. Total $28, 500
6. Laboratory expenses: Drying oven, weighing samples, storage for future examination, reimbursement of travel to lab: Total $7,000
7. Supplies for site and laboratory: sample containers and handling $1000. Misc. flagging, stakes etc. $500. Total $1,500
8. Boat/motor rental: $100/day 10 days Total $1,000
9. Contingency: Unsuitable weather, equipment failure, lack of impoundment level fluctuations necessary for study could result in unexpected delays in data acquisition or need to retain drill crew longer than expected $15,000

Total estimated cost: $94,000

Notes on budget:

1.This estimate does not include indirect costs for project if the study contractor is a university. If the contractor is a consulting firm, the contractor may demand a “cost plus” arrangement. It is assumed that the study would be mounted as a result of an RFP.

2. If a descriptive study lacking much quantitative data was deemed acceptable it could be accomplished by the Expert Panel for an additional 5 days plus the costs of preparing the report, boat rental and other incidental costs or about $30,000.

3. If highly quantitative information on erosion, based upon isotope dilution methodology, was viewed as desirable it is estimated that it could be obtained for an additional $100,000 or a total of about $193,500.

TOWN OF LYME
BOARD OF SELECTMEN
1 HIGH STREET
P.O. BOX 126
LYME, NEW HAMPSHIRE 03768
(603) 795-4639

Simon L. Carr
Richard A. Vidal
Charles J. Smith

February 21, 2013

FERC
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

The Town of Lyme would like to support and be considered a co-signer with O. Ross McIntyre for the proposal of study concerning the Wilder Dam.

Sincerely,

Simon L. Carr, Chair
Selectmen, Town of Lyme NH

Charles J. Smith

Project 1892

City of Lebanon

51 North Park Street
Lebanon, New Hampshire 03766

February 25, 2013

FERC,
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington D.C. 20426

Re: FERC Project 1892-026 – Wilder Dam Relicensing

The City of Lebanon, New Hampshire would like to support and be considered a co-signer with O. Ross McIntyre and the Town of Lyme, New Hampshire for the study proposal submitted to FERC concerning the Wilder Dam Relicensing.

Sincerely,

Gregory D. Lewis

City Manager

City Manager's Office (603) 448-4220 Fax (603) 448-4891

4.2.1 Geology and Soil Resources: Black River, Williams River and Saxtons River at confluence of Connecticut River
Estuaries, specifically Commissary Brook Estuary and Herrick's Cove and Upper Meadows

Goals and Objectives

5.9 (b)(1) – Describe the goals and objectives of each study proposal and the information to be obtained.

The goal of this study is to evaluate the projects operation and maintenance on Riverbank erosion (including the potential effects on protected species, cultural resources and structural integrity) of the Saxtons River Commissary Brook Estuary, Herrick's Cove and Upper Meadows areas.

Specifically the objectives of the study include:

- Identify, describe, classify and map any estuary or wetland issues or concerns, especially on protected species, vegetation and wildlife habitat or invasive species in the reservoir and impoundment area of the dam (and project area below the power plant) that are or will be impacted by erosion
- Identify measures that may be taken to protect or mitigate adverse effects on the vegetative and wildlife communities and wetlands
- Identify, describe, classify and map any issues or concerns in the Saxtons River, Commissary Brook, Herrick's Cove and Upper Meadows from impacts of erosion on approved activities
- Identify measures that may be taken to protect or mitigate adverse effects on the approved activities in the Herrick's Cove

5.9 (b)(2) – If Applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.

Not applicable.

5.9 (b)(3) – If the requestor is not a resource agency, explain any relevant public interest consideration in regard to the proposed study.

Sections 4(e) and 10(a) of the Federal Power Act (FPA) require the Commission to give equal consideration to all uses of the waterway on which a project is located. When reviewing a proposed action, the Commission must consider the environmental, recreational, fish and wildlife, and other non-developmental values of the project, as well as power and developmental values.

Vegetation Communities and the wildlife habitat they support, including wetlands, are resources of particular interest of a variety of reasons including their ecological functions, sporting interest, and subsistence use. Describing the effects on these resources is necessary to fulfill the Commission's responsibilities under NEPA. Ensuring that environmental measures pertaining to these resources are considered in a reasoned way is relevant to the Commission's public interest determination.

Background and Existing Information

5.9 (b)(4) – Describe existing information concerning the subject of the study proposal, and the need for additional information.

- Information on the effects and impacts of erosion on these areas is not in the Pre-Application Document

The general information about the effects and impacts of erosion on the habitats and wildlife on the estuaries, and on the Herrick's Cove approved activities do not take into account recent changes in conditions especially dramatic changes from intensive flooding and overflow's and washouts and that have taken place as the result of Tropical Storm Irene.

Project Nexus

5.9 (b)(5) – Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

Project related activities impact the water levels on the banks and shorelines, thus impacts and effects of erosion the estuaries and coves.

Proposed Methodology

5.9 (b)(6) – Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

Proposed methods include:

- Using a qualified biologist knowledgeable in area vegetation and wildlife, identify, classify and delineate on a map major vegetation cover types, wildlife, and invasive species with special focus on the estuaries
- Using accepted practices evaluate erosion concerns including on access (including time of day, seasons and distance from trails) that may influence approved recreational activities at Herrick's Cove

- Prepare a report that includes an analytical summary and graphical representations of the data from the above studies, including erosion and…. Impacts. All data points used to develop the report (including date and time of collection), should be included within an appendix to the report

Level of Effort and Cost

5.9 (b)(7) – Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

The estimated cost of this study is: $x,xxx. The study may be completed in on study season (12 months).

X to x technicians would be expected to spend x hours each monthly to conduct field work. Report preparation should take a biologist x work days.

4.2.4 Terrestrial Resources: Williams River Estuary and Commissary Brook Estuary, Upper Meadows; – surveying TransCanada properties to document and locate where there are no buffers – (Upper Meadows) – federally endangered species – protection of the Northeastern Bullrush

Goals and Objectives

5.9 (b)(1) – Describe the goals and objectives of each study proposal and the information to be obtained.

The goal of this study is to evaluate the effects of project operations, project recreation and maintenance (including fluctuations in water levels and flow releases) of the project reservoir and stream reaches especially the Commissary Brook Estuary and Williams River Estuary, Herricks Cove, and Upper Meadows on:

- Riparian, wetland, and littoral vegetation community types and the spread of invasive species as a result project operations along the shoreline,
- Wildlife Habitat and Wildlife,
- Riverbank integrity and shoreline erosion and potential effects on riparian vegetation,
- (including frequency, timing, amplitude and duration of reservoir fluctuations) On waterfowl and on riparian and wetland habitats,
- On Bald Eagles and their habitaA

First Objective – survey TransCanada properties to document and locate where there are no buffers with particular attention to the specified areas

Second Objective is to attend to federally endangered species – protection of the Northeastern Bullrush

Third Objective is to identify Invasive species issues particularly at Herrick's Cove, and develop an Invasive species control plan

Fourth Objective is to lookat Eagle Habitat and nesting trees –encourage resources there and that size along the riverbank and enhancing those buffers

Fifth objective of this proposed study is to define a baseline condition that will provide for a better understanding of the potential for project-related effects, and the impact of mitigation measures drafted in 2007 and possible further mitigation strategies.

The objectives of this study include evaluating the success of the following mitigation strategies on the issues listed in the above goals and identify if further mitigation is required:

draft 4/12/07 CT River Joint Commissions

4. Pay more attention to soil conditions, including varves, and to erosion. Towns should work with state geologists to map varves in their towns, to be sure major construction does not take place on unsafe soils. State and federal agencies should examine the severe erosion involving varves at

Commissary Brook, identify its causes, and fund a means to halt the surge of sediment into the Connecticut River mainstem.

5. Retain, protect, and enhance riparian buffers. Towns should require developers and landowners to establish and/or maintain buffers of native vegetation along rivers and streams for privacy and pollution control. Landowners should encourage native plants on their riverbanks and remove invasives.

6. Continue and enhance good river stewardship by TransCanada. Other riparian landowners should follow TransCanada's example of riparian buffer planting on riverfront lands. The Federal Energy Regulatory Commission should include best management practices such as moderated ramping rates in the 2018 license for Wilder and Bellows Falls Dams.

7. Examine culverts to ensure proper drainage. The Cold River flood experience suggests that towns should ask regional planning commissions for help with culvert and bridge surveys to identify those that are undersized. State agencies should assist towns with engineering costs for sizing culverts and bridges. State and local highway departments should ensure that culverts are properly sized when replacing them

during road work, and that culverts for perennial streams do not impede fish movement.

8. Improve stormwater management. Towns should look at ways to include "low impact development" ideas as they review projects, and at how to change existing development to reduce runoff and promote stormwater infiltration.

5.9 (b)(2) – If Applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.

Not applicable.

5.9 (b)(3) – If the requestor is not a resource agency, explain any relevant public interest consideration in regard to the proposed study.

Sections 4(e) and 10(a) of the Federal Power Act (FPA) require the Commission to give equal consideration to all uses of the waterway on which a project is located. When reviewing a proposed action, the Commission must consider the environmental, recreational, fish and wildlife, and other non-developmental values of the project, as well as power and developmental values. Any license issued shall be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses.

Adequate protection of terrestrial resources are essential to the integrity and sustainability of a healthy ecosystem. Describing the project effects on these resources is necessary to fulfill the Commission's responsibilities under NEPA. Ensuring that environmental measures pertaining to these resources are considered in a reasoned way is relevant to the Commission's public interest determination.

Background and Existing Information

5.9 (b)(4) – Describe existing information concerning the subject of the study proposal, and the need for additional information.

- Current information is not sufficiently available in the Pre-Application Document on the baseline measurements or monitoring programs associated with these terrestrial resources. Issues and mitigation plans have been identified as necessary in the past, and sufficient updated information on mitigation success or continued necessity is not available.

Project Nexus

5.9 (b)(5) – Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

Project related activities impact the terrestrial resources along the shoreline in the project area. A profile of the riparian buffers and wetlands and erosion along the shoreline, in the project reservoir and impoundment area is considered necessary to develop a more complete understanding of potential project-related effects.

The requested study would help establish a baseline condition for the system in question, and form the basis for inclusion of potential license requirement to protect the terrestrial resources of the project area.

Proposed Methodology

5.9 (b)(6) – Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

Proposed methods include:

- Using a qualified biologist knowledgeable in area vegetation and wildlife, riparian buffers, wetlands and invasive species; identify, classify and delineate on a map major riparian vegetaion, wildlife, and invasive species with special focus on the riparian buffers and wetlands, and especially impacts of erosion along the shoreline; You may make use of recent existing aerial photography and ground surveys.
- Ground-truth any remote-sensing mapping efforts, record all wildlife observed (directly or indirectly) and any invasive species observed during survey efforts.
- Describe each riparian vegetation type by species, composition, successional stage, and aerial extent within the survey area.
- Record and map the extent of all wetlands identified during survey efforts. Wetland classifications should distinguish the degree of inundation (seasonally flooded, permanently flooded).
- Based on existing literature and opportunistic observations during the vegetation surveys, identify wildlife species that may inhabit or use the identified habitats.
- Prepare a report that includes an analytical summary and graphical representations of the data from the above studies, includes the above mapping effort and identifies, describes, and assesses the extent to which project-related actions and activities may affect the identified habitats and wildlife species dependent on these habitats. All data points used to develop the report (including date and time of collection), should be included within an appendix to the report.

Level of Effort and Cost

5.9 (b)(7) – Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

The estimated cost of this work is: $50,000. The study may be completed in one study season (12 months). 1 or 2 technicians would be expected to spend 1 or 2 days to gather and review existing maps and surveys, 10 days to complete field work, Report preparation should take a biologist x work days and technicians 3 days to finalize and refine maps.

4.2.2 Water Resources: Williams River Estuary and Commissary Brook Estuary, Saxtons River, Herricks Cove, Upper Meadows and CT River Reach around the BF Island (formed by the canal)

Goals and Objectives

5.9 (b)(1) – Describe the goals and objectives of each study proposal and the information to be obtained.

The goal of this study is to evaluate the Water Quantity and Quality of water entering the project area reservoir and impoundment area especially the Saxtons River, Commissary Brook Estuary and Williams River Estuary, Upper Meadows, Herricks Cove and CT River Reach around the BF Island formed by the canal.

One objective is the water quality impacted by the lack of water quantity below the dam in BF, creating a nearly always dry reach, and particularly dissolved oxygen and temperature in this reach.

Second objective of this proposed study is to define a baseline condition that will provide for a better understanding of the potential for project-related effects, impact of mitigation measures drafted in 2007 and possible further mitigation strategies.

The objectives of this study are to evaluate the success of the following mitigation strategies on the issues and identify if further mitigation is required:

draft 4/12/07 CT River Joint Commissions

1. Monitor river water quality to identify problems and track improvements. Town conservation commissions, tributary watershed groups, school groups, and other interested citizens should work with their state's water quality agency to ensure more regular and sustained monitoring of the Connecticut River and its tributaries.

2. Ensure that wastewater discharges no longer compromise the quality of the river.

Communities with combined sewer overflows, including those upstream of the Mt. Ascutney region, should continue their efforts to eliminate them as quickly as possible. EPA should provide funding to assist with these expensive projects. The region is affected by three large wastewater discharges just upstream in the Upper Valley region, as well as those within.

3. Discourage development too close to the river. Towns should adopt ordinances prohibiting building in the 100-year floodplain and ensure that buildings are set a safe distance back from the river even when outside of the floodplain, to reduce the risk of property loss in erodible areas. Vermont should

adopt statewide shoreland protection. NH towns and NH DES should inform landowners about the Shoreland Protection Act, and should not issue permits for projects that violate state law.

8. Improve stormwater management. Towns should look at ways to include “low impact development” ideas as they review projects, and at how to change existing development to reduce runoff and promote stormwater infiltration.

9. Ensure that farm operations help protect water quality. Farmers should employ best management practices and work with conservation districts and the Cooperative Extension Service to prepare a total nutrient management plan for their farm, to make best use of available nutrients, reduce potential for water quality impacts, and save money in purchasing fertilizer.

10. Reduce mercury contamination. The states should continue to act to reduce sources of mercury contamination that affects Connecticut River fish and other wildlife. Congress should join this effort.

5.9 (b)(2) – If Applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.

Not applicable.

5.9 (b)(3) – If the requestor is not a resource agency, explain any relevant public interest consideration in regard to the proposed study.

Sections 4(e) and 10(a) of the Federal Power Act (FPA) require the Commission to give equal consideration to all uses of the waterway on which a project is located. When reviewing a proposed action, the Commission must consider the environmental, recreational, fish and wildlife, and other non-developmental values of the project, as well as power and developmental values. Any license issued shall be best adapted to a comprehensive plan for imporving or developing a waterway or wagterways for all beneficial public uses.

Adequate levels of water quantity and quality, are required by aquatic organisms for subsistence, and are therefore essential to the integrity and sustainability of a healthy ecosystem.   Describing the project effects on these resources is necessary to fulfill the Commission’s responsibilities under NEPA. Ensuring that environmental measures pertaining to these resources are considered in a reasoned way is relevant to the Commission’s public interest determination.

Background and Existing Information

5.9 (b)(4) – Describe existing information concerning the subject of the study proposal, and the need for additional information.

- Current information is not sufficiently available in the Pre-Application Document) (PAD includes ….) or watershed assessment documents on the baseline measurements or monitoring programs associated with water quantity and quality. Issues and mitigation plans have been identified as necessary in the past, and sufficient updated information on mitigation success or continued necessity is not available.

Project Nexus

5.9 (b)(5) – Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

Project related activities impact the water quantity, tributaries and watersheds in the project area impact the water quantity and quality.

The project operations at the dam and canal produce low water quantity entering the reach around the BF Island.

A profile of the water quantity and quality in the project reservoir and impoundment area is considered necessary to develop a more complete understanding of potential project-related effects.

The requested study would help establish a baseline condition for the system in question, and form the basis for inclusion of potential license requirement to protect the water quality of the project area.

Proposed Methodology

5.9 (b)(6) – Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

Using generally accepted practices in the scientific community:

- Monitor and record water quantity and quality with special focus on the estuaries and tributaries. Sampling should take place at least once per week beginning on July 1st and ending on October 1st. During each sampling event, reservoir surface elevation should be recorded

- Monitor and record water quantity and quality at 4 separate sites, beginning at the northernmost estuary/ tributary with subsequent sampling sites located longitudinally downstream from the previous sampling site and at approximately equidistant intervals. Exact locations for the sampling should be chosen at random, using a scientifically accepted method. The habitat type of each sampling location should be identified and recorded (i.e. pool, run, ruffle, etc.)
- Prepare a report that includes an analytical summary and graphical representations of the data from the above studies, including water quantity and quality Impacts. All data points used to develop the report (including date and time of collection), should be included within an appendix to the report

<u>Level of Effort and Cost</u>

5.9 (b)(7) – Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

The estimated cost of this work is: $9,600. The study may be completed in one study season (12 weeks). 2 to 3 technicians would be expected to spend 4 - 5 hours weekly to conduct field work. Report preparation should take a biologist 1 – 2 work days.

4.2.6 Recreation:

Goals and Objectives

5.9 (b)(1) – Describe the goals and objectives of each study proposal and the information to be obtained.

The goal of this study is to evaluate the adequacy of existing recreation and public use facilities in meeting existing and future regional public use and river access needs, the effect of project operations on quality an d availability of flow-dependent and water level-dependent recreation opportunities, including boating, and the adequacy of structural integrity, physical capacity, and/or management methods to support recreation use at existing facilities.

Specifically the objectives of the study include:

- Assess the adequacy of the Herrick's Cove recreation area and potential improvements, to include camping, kayaking and sanitary facilities within the area's proximity
- Assess the opportunity for a state park on and around the Herrick's Cove area and the additional TransCanada land in that proximity and including adjoining private property whose landowners' have expressed interest
- Assess the adequacy of multi-day canoe/kayak trips north and south of the dam and available access points, camping and sanitary facilities – including access and portage requirements for example – transportation requirement to travel from above the project area to below the project area
- Assess the existing Trail Systems and the opportunity for connectivity including the around the Herrick's Cove area through the village and north through Rockingham and Springfield, and connecting the Island to the Historic Riverfront Park and Trail System, connecting to Pinnacle Trail system,
- Assess implementation of the Bicycle-pedestrian rails and trails multi-use pathway from Northfield, MA to Bellows Falls, (see existing information – feasibility study)
- Evaluate the effects of project operation on the availability of whitewater recreational opportunities downstream for the BF Dam and to identify potential measures to alleviate those effects and to enhance whitewater boating opportunities – determine the range of flows and the optimum flow that would provide whitewater boating opportunities in the project bypassed reach of the CT River around the BF Island
- Assess the adequacy of the recreation management an d controls with special focus on the Island area where the Canal and PowerPlant reside – managing and staffing the Visitor areas – Fish Ladder and Waypoint Center
- Assess the adequacy of management of the CT River Byways and specifically the Waypoint centers on the Byway along the 3 project areas of Vernon to White River Junction

5.9 (b)(2) – If Applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.

Not applicable

5.9 (b)(3) – If the requestor is not a resource agency, explain any relevant public interest consideration in regard to the proposed study.

Sections 4(e) and 10(a) of the Federal Power Act (FPA) require the Commission to give equal consideration to all uses of the waterway on which a project is located. When reviewing a proposed action, the Commission must consider the environmental, recreational, fish and wildlife, and other non-developmental values of the project, as well as power and developmental values. Any license issued shall be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses.

Ensuring that these recreational resources are considered in a reasoned way is relevant to the Commission's public interest determination. Windham Regional Commission - Regional Plan Section 7.10: "Bicycling and walking are also expected to continue strong growth in popularity and with it, support for multi-use paths, trails, and linear parks or greenways" and "The Windham Region is rich in water resources. Residents and visitors utilize the many rivers, streams, lakes, reservoirs, and ponds for water recreation such as swimming, boating, and fishing. There is a shortage of access"

Rockingham Town Plan:

Policies 1. The use and development of land and waters should take into consideration the impact on recreational activities such as hunting, fishing, hiking, canoeing and boating, skiing, horseback riding, snowmobiling and other outdoor recreational activities.

And 6. The community, working with public and private organizations and individuals, should encourage improved access to the Connecticut River resources.

Action Steps: 4. Improve existing and establish new access to local rivers.
*Work with the Bellows Falls Historical Society (BFHS) in the area off Mill St. to create a riverside park and historic interpretive walkway.
*Work with the Town of Westminster and Bellows Falls Union High School to connect the BFHS interpretive path system to the Basin Farm and other trail systems.
*Evaluate the feasibility of creating a pathway from Bellows Falls to Herrick's Cove.
* Encourage Saxtons River Village to create a park on village land adjacent to the Centennial Bridge and waterfalls, and a walkway along the village land.

6. The Selectboard and Planning Commission will review concerns and other issues dealing with Herrick's Cove and recreational uses along the Connecticut River in anticipation of participating in the TransCanada FERC license renewal process in 2018.

7. The Development Office shall investigate and develop a preliminary plan for a system of paths for non-motorized travel such as hiking, cross-country skiing, horseback riding, and bicycling. For example, a Williams River trail, a Parker Hill trail, and a Darby Hill trail. Separate trails are recommended for snowmobiling and all-terrain vehicles.
8. The Development Office shall work with the Bellows Falls Union High School District and the Rockingham and Upper Valley Land Trusts to develop an assessment study for a path system to connect Bellows Falls through the Basin Farm areas with trails on the Bellows Falls Union High School land.

Background and Existing Information

5.9 (b)(4) – Describe existing information concerning the subject of the study proposal, and the need for additional information.

- Information on the Herricks Cove Recreational Area does not assess the current adequacy of the recreational area

- Information on the trails systems of various organizations – does not assess the adequacy of connectivity between trail systems and information for user-friendliness

- A Northfield to Bellows Falls rails with trails multi-use path feasibility study Final Report September 2001: For Windham Regional Commission, funded by Vermont Agency of Transportation, prepared by Stevens & Associates, PC and Ms. Kathleen D. Williams, Brattleboro, VT in association with Alta Transportation – Mr. Michael Jones San Rafael, California; Buckhurst Fish & Jacquemart, New York, NY; Monroe Whitaker/Landscape Architect (MW/LA) Brattleboro, VT assesses the feasibility and lays out a plan - needs implementation

- An informational memorandum by American Whitewater and New England FLOW

- Windham Regional Planning Commission and Southern Windsor County Regional Planning Commission information varies regarding preparation and publication for user-friendliness and does not adequately address the connectivity issue

Project Nexus

5.9 (b)(5) – Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

The project area includes a huge area, including recreational watershed and reservoir areas that are the prime outdoor recreational areas in the extensive region of the project area. The area is a prime spot for a state park.

Proposed Methodology

5.9 (b)(6) – Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

Proposed methods include:

Field reconnaissance surveys and community participation, consulting with:

For the Management of the Byway and Waypoint Centers - the Byways Commission, the Regional Planning Commissions (Windham and Southern Windsor County), the Grafton Nature Museum, the Rockingham Historical Society (CLG Commission), the Bellows Falls Historical Society, the and the local Waypoint Committees, Bellows Falls Downtown Development Association and the Greater Falls Regional Chamber of Commerce

For the Herricks Cove Recreation Area – the Rockingham Conservation Commission, the VT State Parks, the Grafton Nature Museum, the Rockingham Historical Society (CLG Commission), the Bellows Falls Historical Society, and the Greater Falls Regional Chamber of Commerce and including the trail connectivity below

For Trail Connectivity - Windmill Hill Pinnacle Association, National Park Service River and Trails System, VT Trail and Greenways Associations - Council – (of Trail Councils), VT Forests and Parks, and the Regional Planning Commissions And for the biking trails specifically add the VT Bicycle and Pedestrian Coalition

For Whitewater boating opportunities - controlled flow study of a range of alternative flow releases and determine the minimum and optimum in-stream flow needed for whitewater boating in the BF Island Reach and prepare a report that describes the whitewater boating attributes of the range of flows examined, including level of difficulty, portage requirements, length of trip, experiences, etc.

<u>Level of Effort and Cost</u>

5.9 (b)(7) – Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

The estimated cost of this study is:

Hiking Trails, Biking Trails Herrick's Cove, state park, Byways and Waypoint Centers - Field reconnaissance and surveys: estimated to be $50,000 to $75,000 depending on the intensity of the surveys; 1 to 2 technicians per project area for 40 hours per week for 2 to 4 weeks to conduct field work. Report Preparation 1 to 2 days per project area.

Whitewater Boating opportunity $5,000. The study may be completed in on study season (12 weeks).

1 to 2 technicians would be expected to spend 4 hours each to prepare the study plan; 1 to 2 days of field work conducting and documenting study flows, and 1 to 2 days preparing the report – this does not include the cost of providing the flows.

4.2.8 Aesthetic Resources:
Adequacy of aesthetic resources in the project area

Goals and Objectives

5.9 (b)(1) – Describe the goals and objectives of each study proposal and the information to be obtained.

The goal of this study is to evaluate the adequacy of the aesthetics between the dam and the Hydro Power Plant area
Canal – assess the need for improvements to cement sides of canal and bridges over the canal, to put the electrical lines along the canal underground, streetscape improvements to rear (canal) facing building facades on Canal St. to complete fencing improvements along the canal, to improve the walkways and sidewalks, signage and lighting on the Island, improve sight and walking connections between the Island and the downtown, and assess the possibility for periodic flow reduction for (bonfire display or other scenic 3rd Friday opportunity - visitor draw like Providence R.I. has), study of the impact of the project on revitalization of the Island in general and participating in the realization of Island Master Plan improvements

Specifically the objectives of the study include:

- Assess the adequacy of the aesthetics of the Canal
- Assess the adequacy of the aesthetics of the Bridges over the canal
- Assess the adequacy of the aesthetics of the Reach around the "Island"
- Assess the adequacy of pedestrian and visitor facilities on the Island

5.9 (b)(2) – If Applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.

Not applicable.

5.9 (b)(3) – If the requestor is not a resource agency, explain any relevant public interest consideration in regard to the proposed study.

Sections 4(e) and 10(a) of the Federal Power Act (FPA) require the Commission to give equal consideration to all uses of the waterway on which a project is located. When reviewing a proposed action, the Commission must consider the environmental, recreational, fish and wildlife, and other non-developmental values of the project, as well as power and developmental values. Any license issued shall be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses.

Ensuring that these aesthetic resources are considered in a reasoned way is relevant to the Commission's public interest determination. As supported in the Rockingham Town Plan Chapter 8 on Historic Resources: Goal 3 - To encourage the preservation, restoration, rehabilitation, repair, and adaptive re-use of historic houses, outbuildings, barns, commercial and industrial buildings, and bridges; and Action Steps - 2. The Town will seek grant funds for streetscape improvements to the rear building facades on Canal Street; 11. Encourage the preservation and interpretation of historically significant industrial and commercial sites, including manufacturing, mining, papermaking, energy production, agriculture and transportation; will continue Town support for the Connecticut River Byway and Waypoint Center including working with adjacent Towns, businesses and other organizations. Seek additional grants for 86 Rockingham Town Plan revolving displays, and a Waypoint curator to coordinate exhibits in conjunction with other Interpretive Centers; 16. The Town will continue to support the creation of a railroad museum in the Island/Downtown Bellows Falls National Register Historic District in cooperation with the active railroads in the Town and State. 17. Under Town direction, continue to participate in environmental assessment and necessary remedial action, to further re-use and/or rehabilitation of the Town owned TLR mill buildings on Mill St., Bellows Falls. 18. The Town, through the Development Office, will seek funds for a feasibility study for a regional Connecticut River archeological study center located in Bellows Falls and sited in underutilized historic buildings, such as the TLR mill buildings.

<u>Background and Existing Information</u>

5.9 (b)(4) – Describe existing information concerning the subject of the study proposal, and the need for additional information.

- An Island Revitalization Master Plan is underway that is providing recommendations for these aesthetics

- An informational memorandum by American Whitewater and New England FLOW

- Regional Planning Commission information as available

<u>Project Nexus</u>

5.9 (b)(5) – Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

The aesthetics between the dam and the Hydro Power Plant area are really detrimental to residents, visitors and tourists, including the areas depleted of water by the dam, the crumbling canal and bridges over the canal.

Proposed Methodology

5.9 (b)(6) – Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

Proposed methods include:

There is currently a planning study that will make some recommendations along these lines – will be completed in April 2013.

Field reconnaissance surveys and community participation, consulting with:

For the Canal Aesthetics, BF Island Reach, and General Island Aesthetic and Infrastructure Improvement - the Byways Commission, the Grafton Nature Museum, the Rockingham Historical Society (CLG Commission), the Bellows Falls Historical Society, the and the local Waypoint Committees, the Bellows Falls Downtown Development Association (BFDDA), Rockingham Planning Commission and Island Revitalization Committee

For the Bridges – Windham Regional Commission and Town Engineer/Highway Dept and BFDDA

Level of Effort and Cost

5.9 (b)(7) – Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

- Field reconnaissance and surveys: estimated to be $20,000 to $35,000 depending on the intensity of the surveys; 1 to 2 technicians per project area for 20 hours per week for 2 to 4 weeks to conduct field work. Report Preparation 1 to 2 days per project area.

For Canal Visitor opportunities - controlled flow study of a range of alternative flow releases and determine the minimum and optimum in-stream flow needed for periodic activity such at the Providence, RI Canal light shows and prepare a report that describes the canal attributes of the range of flows examined, including level of difficulty for implementing a visitor – tourist visual activity, etc.

Canal Visitor tourism opportunity $5,000. The study may be completed in on study season (12 weeks).

1 to 2 technicians would be expected to spend 4 hours each to prepare the study plan; 1 to 2 days of field work conducting and documenting study flows, and 1 to 2 days preparing the report – this does not include the cost of providing the flows.

TROUT UNLIMITED
DEERFIELD RIVER CHAPTER

10 Old Stage Road
Wendell, MA 01379

March 1, 2013

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E., Room 1A
Washington, DC 20426

Vernon Project, FERC No. 1855
Bellows Falls Project, FERC No. 1904
Study Requests of Trout Unlimited

Dear Secretary Bose:

Following are Trout Unlimited's (TU) study requests for the Vernon Project and the Bellows Falls Project.

STUDY REQUESTS

Requested Study No. 1
Shad Population Model for the Connecticut River
FERC No. 1904 & FERC No. 1855

Develop an American shad annual step, mathematical simulation population model for the Connecticut River to quantify how project operations and potential restoration/mitigation measures impact the population of shad in the Connecticut River.

Goals and Objectives

The goal of the model is to assess impacts of both upstream and downstream passage at each of the Connecticut River projects and potential management options for increasing returns to the river.

Specific objectives include:

- Annual projections of returns to the Connecticut River;
- A deterministic and stochastic option for model runs
- Life history inputs of Connecticut River shad
- Understanding the effect of upstream and downstream passage delay at projects

- Calibration of the model with existing data
- Analysis of the sensitivity of model inputs
- Analysis of sensitivity to different levels of up- and downstream passage efficiencies at all projects
- Multiple output formats including a spreadsheet with yearly outputs for each input and output parameter

Resource Management Goals

The requestor is not a public agency. However, we believe the information gathered as a result of this study would further regional resource management goals, and more specifically The Connecticut River Atlantic Salmon Commission's *Management Plan for American Shad in the Connecticut River.*

Public Interest

The Northfield Mountain Project and the Turners Falls Project and other projects in the upper Connecticut River alter flows, impacting aquatic species and communities and specifically American shad movement and spawning. Flow alterations caused by the cumulative effects of all projects in the Connecticut River affect the public's use of the river for recreation. Angling for shad is directly impacted by a reduced population caused by hydroelectric projects on the river.

Existing Information

Since the construction of the first fish lift facility at Holyoke Dam in 1967, American shad have had access to spawning and rearing habitat upstream from Holyoke Dam. A number of improvements to the Holyoke fishway have occurred since that time, but while the numbers of shad lifted at Holyoke have reached as much as 721,764 and the overall shad population to the river exceeded 1.6 million shad in 1992 (CRASC 1992), total shad populations, and numbers of shad passing Holyoke, Turners Falls and Vernon Dam have not met CRASC management goals.

Population and passage numbers past Holyoke have declined substantially from those totals in recent years, with average Holyoke passage numbers since 2000 of 229,876. Whole river population estimates have shown that approximately half of the returning population of shad passing upstream of Holyoke. Recent returns to Holyoke are far below management goals. Average passage efficiency of shad at Turners Falls (Gatehouse counts) and Vernon since 2000 has been 3.1 and 20.4 % respectively. These too are well below the CRASC management goals.

Safe, timely and effective up- and downstream passage along with successful spawning and juvenile production are necessary to help achieve shad management goals for the Connecticut River.

Project Nexus

Existing project operations and fish ladder efficiencies have a direct effect on shad populations in the Connecticut River. Poor upstream passage efficiencies and delays restrict river access to returning shad. Fish unable to reach upriver spawning grounds may not spawn or have reduced fitness or survival of young. Poor downstream passage survival and downstream passage delays affect outmigration and consequently repeat spawning, an important ecological aspect of the iteroparous Connecticut River shad population (Limberg et al. 2003).

TU is concerned that poor passage efficiencies and delays at projects may be limiting access to upstream reaches of the river, altering spawning behavior, decreasing outmigration survival and contributing to the failure of the Connecticut River shad population to meet management targets (Castro-Santos and Letcher 2010).

Development of a population model will allow an assessment of individual project impacts on the population as well as the cumulative impacts of multiple projects. The model will allow managers to direct their efforts in the most efficient manner toward remedying the conditions that most impact the shad population.

Proposed Methodology

Population models are commonly used to assess anthropomorphic and natural impacts and are consistent with accepted practice. A model similar to this request was constructed for the Susquehanna River by and Normandeau Associates Inc. for Exelon (FERC #405, RSP 3.4). The model is constructed in Microsoft Access and would have a ‘dashboard’ entry screen that allows individual entry of the parameters listed below.

Specific parameters that would be included in the model:

- Upstream passage efficiency at Holyoke, Turners Falls (Cabot, Gatehouse and Spillway Ladders), Vernon fishways, and any impacts associated with Northfield Mountain.
- Distribution of shad approaching the Turners Falls project between the Cabot Ladder and the spillway at the dam
- Downstream passage efficiencies at Vernon, Northfield Mountain, Turners Falls, and Holyoke projects for juveniles and adults
- Entrainment at Mount Tom and Vermont Yankee
- Sex ratio of returning adults
- The proportion of virgin female adults returning at 4, 5, 6, and 7 years
- The proportion of repeat spawning females at 5, 6 and 7 years
- Spawning success of females in each reach
- Fecundity
- Percent egg deposition
- Fertilization success
- Larval and juvenile in-river survival
- Calibration factor to account for unknown parameters such as at sea survival
- Options for fry stocking and trucking as enhancement measures
- Start year and model run years
- Start population
- Rates of movement to and between barriers

- Temperature, river discharge, and other variable of influence to migration and other life history events

The model should be adaptable to allow the input of new data and other inputs.

Level of Effort and Cost

Neither First Light nor TransCanada have proposed any study to meet this need. Estimated cost for the study is expected to be low to moderate. As the model describes the impacts of multiple projects and two owners, both project owners would share the cost of model development.

Literature cited:

CRASC (Connecticut River Atlantic Salmon Commission). 1992. A management plan for American shad in the Connecticut River basin. Sunderland, MA

Castro-Santos, T and B. H. Letcher. 2010. Modeling migratory bioenergetics of Connecticut River American shad (*Alosa sapidissima*): implications for the conservation of an iteroparous anadromous fish. Can.J.Fish.Aquat.Sci. 67: 806-830

Limberg, K. E., K. A. Hattala, and A. Kahne. 2003. American shad in its native range. Pages 125-140 in K. E. Limberg and J. R. Waldman, editors. Biodiveristy, status and conservation of the world's shads. American Fisheries Society, Symposium 35, Bethesda, Maryland

Requested Study No. 2
Telemetry Study of Upstream and Downstream Migrating Adult American Shad to Assess Passage Routes, Effectiveness, Delays, and Survival
FERC No. 1904 & FERC No. 1855

Goals and Objectives

Assess behavior, approach routes, passage success, survival, and delay by adult American shad as they encounter the projects during both upstream and downstream migrations, under permitted project operations conditions, proposed operational conditions, and study treatment operational conditions at First Light Power's Turners Falls and Northfield Mountain Pumped Storage projects and TransCanada's Vernon Project. There are multiple fishways and issues related to both upstream and downstream passage success at the projects. Some of these issues at the Turners Falls Project are similar to and/or pertain directly to the Northfield Mountain and Vernon projects. Therefore, it is reasonable to address passage issues at all projects in a similar manner.

<u>Telemetry Study -</u> This requested study requires use of radio telemetry using both radio and Passive Integrated Transponder (PIT) tag types to provide information to address

multiple upstream and downstream fish passage issues. The following objectives shall be addressed in these studies:

- Assessment of any migration delays resulting from the presence of the dam and peaking flow operations of the Turners Falls Project;
- Determine route selection and behavior of upstream migrating shad at the Turners Falls Project under various spill flow levels (e.g., movement to the dam, attraction to Cabot Station, attraction to Station 1 discharge, movement between locations, delay, timing, etc.). A plan and schedule for dam spill flow releases will need to be developed that provides sufficient periods of spill flow conditions, and various generating levels from Turners #1 Station coupled with Cabot Station generation flows (e.g., treatments will require multiple days of consistent discharge). Evaluated spill flows should include flows between 2,500 – 6,300 cfs, which relate to bypass flows identified as providing spawning opportunities for shortnose sturgeon in the lower bypass reach at the Rock Dam. (Kieffer and Kynard 2012). Sturgeon spawning and upstream shad passage occur concurrently;
- Assess near field, attraction to and entrance efficiency of the Spillway Ladder by shad reaching the dam spillway, under a range of spill conditions;
- Evaluate the internal efficiency of the Turners Falls Spillway Ladder;
- Continue data collection of Cabot Station Ladder and Gatehouse Ladder efficiency, to include rates of approach to fishway entrances, entry into fishways, and passage through them, under different operational conditions that occur in these areas;
- Evaluate modifications to the Cabot and/or Spillway fishways recommended by the agencies if they are implemented;
- Assess upstream migration from Turners Falls to the Vernon Dam in relation to Northfield Mountain's pumping and generating operations and Vernon Project peaking generation operations. Typical existing and proposed project operation alterations should be evaluated;
- Assess near field, attraction to and entrance efficiency of the Vernon Dam Ladder;
- Assess internal efficiency of the Vernon Dam Ladder;
- Assess upstream passage past Vermont Yankee's thermal discharge (also located on the west bank of the river 0.45 mile upstream of fish ladder exit)
- Assess upstream migration from Vernon Dam in relation to the peaking generation operations of the Bellows Falls Project. Typical existing and proposed project operation alterations should be evaluated;
- Determine post-spawn downstream migration route selection, passage efficiency, delays and survival related to the Vernon Project, including evaluation of the impact of the Vermont Yankee heated water discharge plume on downstream passage route, migrant delay/timing, efficiency and survival;
- Assess impacts of Northfield Mountain operations on up- and downstream adult shad migration, including delays, entrainment, and behavioral changes and migration direction shifts under existing and proposed project operations;
- Determine downstream passage route selection, timing/delay, and survival under varied project operational flows into the power canal and spill flows at Turners Falls Dam;

- Determine downstream passage route selection, timing/delay in the canal, Cabot Station fish bypass facility effectiveness, and survival of Cabot-bypassed adult shad that enter the Turners Falls Canal system;
- Compare rates and or measures of delay, movement and survival etc., among project areas or routes utilized (e.g., spill at dam vs. power canal) under the range of permitted and proposed conditions; and
- Utilize available data sets and further analyze raw data (e.g., 2003- 2012 Conte Lab Studies) where possible to address these questions and inform power analyses and experimental design.

Information to address all of these questions would rely on the tagging of upstream migrating adult shad at Holyoke Dam and releasing them to migrate naturally from Holyoke through the Turners Falls and Vernon projects and back downstream after spawning. Additional tagged individuals would likely need to be released farther upstream (Turners Falls Canal, upstream of Turners Falls Dam, and upstream of Vernon Dam), to ensure that enough tagged individuals encounter project dams on both upstream and downstream migrations, that these individuals are exposed to a sufficient range of turbine and operational conditions to test for project effects, and to provide adequate samples sizes for statistically valid data analyses to address the many objectives listed. This study will require two years of field data collection to attempt to account for inter-annual variability in river discharge and water temperatures.

<u>Evaluation of Past Study Data</u>- In addition to collection and analysis of new telemetry data, substantial data has already been collected at Turners Falls from multiple years of passage assessments conducted for First Light by U.S. Geological Survey's Conte Anadromous Fish Research Center (Conte Lab) researchers and there are also data from the 2011 and 2012 full river study conducted by the Conte Lab that address Turners Falls, Northfield Mountain and Vernon project migration and passage questions that have not yet been analyzed. These data include several million records each year from more than 30 radio telemetry receivers deployed between Middletown, CT and Vernon Dam. This data will provide substantial information free from the field data collection costs and therefore should be analyzed as part of this study. This data analysis should be completed in 2013 to help inform the design of subsequent field studies.

<u>Evaluation of Methods to Get Shad Past Cabot Station for Spillway Passage at the Turners Falls Dam</u> – The poor passage efficiency of the Cabot Ladder, the first and most used fishway encountered by shad arriving at the Turners Falls Project, and at the entrance to the Gatehouse Ladder, which all Cabot fishway-passed fish must use, has resulted in very poor overall shad passage efficiency at the project. An alternative to passing fish at the Cabot Station is to install a fish lift at the dam that would put fish directly into the Turners Falls pool, thereby eliminating problems with the Cabot Fishways, and the Gatehouse Fishway entrance and the variable passage efficiency of the Gatehouse Fishways. For this to be effective, attraction of shad to the Cabot Station discharge and associated delays would need to be overcome. It is possible that spillway flow releases coupled with behavioral measures at Cabot Station that dissuade shad from

that tailrace could achieve this end. In order to assess the possibilities, we recommend the following study:

1. A literature search and desk-top assessment of the possible behavioral measures that could be effective in getting shad to pass Cabot Station tailrace and continue upstream to the dam.
2. Based on results of the desk-top assessment, possible evaluation of behavioral measures that are likely to be effective.
3. Field evaluation of the effect of different levels of spill at the dam that would induce fish to move past the Cabot Station into the bypass reach and up to the dam (as noted in objectives).

Besides passage success and delays at passage facilities, these studies would assess the impacts of project operations on migration passage delay, route, timing, injury, mortality, and passage structure attraction, retention, and success. Of particular interest will be fish behavior during periods when flow releases from the project increase from the required minimum flows to peak generation flows and when flows subside from peak generation flows to minimum flows and the operation of NMPS in pumping and generation modes.

Resource Management Goals

The requestor is not a public agency. However, we believe the information gathered as a result of this study would further regional resource management goals, and more specifically The Connecticut River Atlantic Salmon Commission's *Management Plan for American Shad in the Connecticut River*.

Public Interest

The Northfield Mountain Project and the Turners Falls Project and other projects in the upper Connecticut River alter flows, impacting aquatic species and communities and specifically American shad movement and spawning. Flow alterations caused by the cumulative effects of all projects in the Connecticut River affect the public's use of the river for recreation. Angling for shad is directly impacted by a reduced population caused by hydroelectric projects on the river.

Existing Information

Passage of adult shad at the Turners Falls fishway complex has been the subject of intense study by the Conte Lab since before 1999. These studies have clearly demonstrated that passage through the existing fishways at Cabot and Spillway is poor (<10% in many years). Passage through the Gatehouse fishway is better, but still rarely exceeds 80%, despite the short length of this ladder. In addition to poor passage for fish entering the ladders, shad that ascend the Cabot Fishway experience extensive delays before entry into the Gatehouse Fishway. Shad that ascend Spillway frequently fall back into the canal and are also subject to these upstream delays. A new entrance to the Gatehouse Fishway installed in 2007 led to dramatic improvements in passage out of the canal (from 5% to over 50% in 2011), but passage still falls well short of management goals. In addition, shad spend considerable time (up to several weeks) attempting to pass. These delays likely influence spawning success and survival. Adult shad, unable to pass Gatehouse, experience similar delays in downstream passage, even after they have stopped trying to pass Gatehouse. Without spill, all outmigrating shad that have passed Gatehouse must enter the canal at the Gatehouse and may be subject to delays exiting the canal.

During the course of these studies a very large dataset has been compiled that could yield useful information for further improving passage of shad out of the canal in both the upstream and downstream directions. A unique feature of these data is a 2-dimensional array covering the canal just downstream of Gatehouse, documenting fine scale movements and occupancy of this zone. These data should be combined with computational fluid dynamics (CFD) and real-time hydraulic data to determine how canal hydraulics influence the ability of shad to locate and enter the fishway, and to identify modifications that are likely to lead to improvements in approach and entry rates. A separate CFD modeling study is requested that includes modeling of the Gatehouse Fishway entrance are at the head of the power canal.

In addition, whole-river shad telemetry studies performed in 2011 and 2012 will likely provide useful information and should be analyzed. These data should allow quantification of delay below Turners Falls, and could help guide studies requested above. Preliminary analyses of data through 2011 have been made available to FirstLight and the resource agencies (Castro-Santos and Haro 2005; Castro-Santos and Haro 2010).

The whole-river studies have also shown that, at least in 2011, most shad that pass Turners Falls rapidly progress upstream to Vernon Dam where extensive delays also occur. Data from the 2012 study were not available at this time, but Dr. Castro-Santos stated similar patterns were noted in the data between the years on the topic of upstream delay (personal communication, Dr. Theodore Castro-Santos). Similarly, concerns relative to the downstream passage of spent shad also remain relative to delays, with existing unpublished USGS telemetry data sets suggesting this is an issue within the Turners Falls canal.

Since the first year of operation of the Turners Falls upstream fishways (1980), the percent passage of American shad annually passed upstream of Turners Falls Dam compared to the number passed at the Holyoke Fish Lift has averaged 3.6% (1980-2012 data). The highest values for this metric has not exceed 11% and are well below the noted CRASC Management Plan target range for this objective noted earlier as 40-60% on a five year running average.

Since the first year of operation of the Vernon Dam upstream fish ladder (1981), the percent passage of American shad annually passed at Vernon compared to the number passed upstream of Turners Falls Dam (Gatehouse counts) has averaged 39.4%, ranging from 0.42% to 116.4% (> 100% due to counting error at one or both facilities, unknown).

Project Nexus

Existing project operations (peaking power generation) and limited bypass flows have a direct impact on instream flow and zones of passage (migration corridors). Project flow releases affect passage route selection, entry into fishways, and create delays to upstream migration. Inefficient downstream bypasses can result in migration delays and increased turbine passage. Mortality of adult shad passing through these turbines is expected to be high (Bell and Kynard 1985), additional stresses associated with passage and delay may cause mortality as shad are unable to return to salt water in a timely manner. The project's upstream and downstream passage facilities need to be designed and operated to provide timely and effective upstream and downstream fish passage to meet restoration goals of passage to upstream habitat and maximize post-spawn survival. These factors are all critically important to the success of restoration efforts.

Proposed Methodology

Use of radio including passive-integrated transponder (PIT) telemetry is widely accepted as the best method to assess fish migratory behavior and passage success and has been used extensively to assess migration and passage issues at Turners Falls as well as other Connecticut River projects. These studies include one conducted in 2011 and 2012 by the U.S. Fish and Wildlife Service and U.S. Geological Survey's Conte Anadromous Fish Research Center, which has provided substantial information related to some of the issues identified here. The requested study will build and expand on the information collected over the past two years.

The study design must specify sample sizes, tag configurations and receiver configurations, to ensure that rates of entry and exit to the tailraces, fishways, downstream bypasses, and the bypassed reach can be calculated with sufficient precision to determine effectiveness of flow and ensonification treatments (separate Study Request). For project assessments at Turners Falls (e.g., Cabot, Spillway and Gatehouse ladder attraction and entry, route selection, operational effects), double tagged (radio and PIT) shad will be required for release from Holyoke Dam. Additional shad must be released directly into the Turners Falls Canal to support assessment of the various operational and structural conditions in effect, to be modified in this period, and proposed conditions within the Turners Falls power canal relative to entrances to the Gatehouse fishway. A related request on CFD modeling in the Cabot Station tailrace, the upper power canal near Gatehouse, and in the area around the entrance of the Spillway Ladder will address related project operational effects that will also address identified objectives in this telemetry request. Shad captured at Holyoke and tagged and release upstream of Turners Falls Dam, or tagged out of Gatehouse Ladder, would help to ensure an adequate sample size for evaluations in the vicinity of NMPS and to the Vernon Dam and the ability to address identified study objectives in those project areas. Additional tagged shad are expected to be required for release upstream of the Vernon Dam, which should ensure adequate sample for a separate study request, where shad spawn upstream of Vernon Dam as well as ensuring there is an adequate number of outmigrating spent adults to address related study objectives for adult outmigrants. The required number of tagged fish to address study objectives may be adjusted accordingly from area to area depending on target numbers (i.e., best information on resultant viable tagged fish and power analyses to detect effects) to account for typical passage rates, survival rates, and handling effects as examples.

Existing information on captured, handled, tagged fish performance (e.g., percent that drop back, unsuitable for tracking) and factors such as timing of tagging and potentially transport, must all be carefully considered to ensure an adequate sample size of healthy (e.g., viable to characterize behavior, survival, etc.) tagged fish is available to address the many questions identified in this request (as supported by a statistical power analysis). Additionally, ensuring adequate downstream adult fish sample sizes (to address project effect questions above) requires close consideration as expected losses of healthy tagged fish during upstream passage, natural mortality rates, and tagging related effects, are expected to reduce sample sizes on downstream passage objectives/questions as the season progresses. The use of single PIT tagged fish can help improve sample sizes, but will be of limited use to answer some of the passage questions we have identified.

Due to environmental variability, two years of study work will be necessary. A large array of stationary monitoring stations (radio and PIT) will be needed to address the issues identified among the project areas. A sufficient level of radio receiver and PIT reader coverage will be required, to provide an appropriate level of resolution, for data analyses, to answer these questions on project operational effects. The study will provide information on a variety of structural and operational aspects of fish migration, relative to route selection, timing, survival, and up and downstream passage attraction, retention, delay, efficiency, survival as some examples at three projects (Turners Falls, NMPS, and Vernon). The use of video monitoring may also be utilized for specific study areas such as the Spillway Ladder, to provide additional information on shad entrance activity, with the understanding of some data limitations associated with this approach (fish identification, water visibility). This study will be coordinated with the proposed study request to evaluate ensonification as a shad behavioral deterrent at the Cabot Station tailrace which will be an additional treatment of the telemetry study.

In addition to the tagging studies, use of video monitoring of the Spillway Fishway would provide additional overall data on Spillway Fishway efficiency as all shad attempting to pass could be monitored versus just those shad that have been tagged.

Level of Effort and Cost

The requested study is extensive and will require a substantial effort and cost to capture, PIT tag, and radio tag a sufficient number of shad at Holyoke to release at upstream locations. We are not aware of any other study technique that would provide project specific fish behavior and migration information to adequately assess existing project operations and provide insight in possible alternative operations and measures needed to address observed negative impacts to fish migration success. Cost for the entire multi-project tagging, tracking and data analysis are expected to range from $400,000 to $500,000 based on past Turners Falls' studies and the 2011 and 2012 shad telemetry studies. Video monitoring of the Spillway fishway would add a modest cost to this study.

Due to the fact tagged shad will move throughout the larger five project area, to varying degrees, there will be expected cost savings (e.g., radio tags) to both owner/operators, provided cooperation in study planning and implementation occurs.

Literature Cited

Atlantic States Marine Fisheries Commission. 2010. Amendment #3 to the interstate fishery management plan for shad and river herring (American shad management). Washington, D.C.

Bell, C. E. and B. Kynard. 1985. Mortality of adult American shad passing through a 17-megawatt Kaplan turbine at a low-head hydro-electric dam. North American Journal of Fisheries Management, 5:33-38.

Castro-Santos, T. 2011. Analysis of American shad passage at Vernon Dam 2011. USGS Conte Lab Internal Report

Castro-Santos, T. and A. Haro. 2005. Turners Falls fish passage studies 2005: results from PIT and radio telemetry studies. CAFRC Internal Report # 2005-04.

Castro-Santos, T. and A. Haro. 2010. Gatehouse fishway telemetry studies: progress report, 2008-2010. USGS CAFRC Internal Report.

Kieffer, M. and B. Kynard. 2012. Spawning and non-spawning migrations, spawning, and effects of river regulation on spawning success of Connecticut River shortnose sturgeon. In Life history and behavior of Connecticut Rver shortnose sturgeon and other sturgeons. B. Kynard, P. Bronzi, and H. Rosenthal Editors. World Sturgeon Conservation Society: Special Publication #4. Norderstedt, Germany.

Requested Study No. 3
Impact of Project Operations on Shad Spawning, Spawning Habitat, and Egg Deposition in the Project Areas of the Turners Falls, Northfield Mountain Pumped Storage and Vernon Project Areas and downstream from Bellow Falls Dam
FERC No. 1904 & FERC No. 1855

Conduct a field study of spawning by American shad in the Connecticut River mainstem downstream of Turners Falls Dam, in the Turners Falls Dam impoundment, in the Vernon Dam Project area, and downstream of Bellows Falls Dam to determine if project operations (including operations of the Northfield Mountain Pump Storage) negatively impact shad spawning behavior, spawning habitat use, areal extent and quality of those spawning areas, and spawning activity in terms of egg deposition in those areas.

Goals and Objectives

Determine if project operations (under the permitted and proposed operational ranges) affect American shad spawning site use and availability, spawning habitat quantity and quality, and spawning activity in the river reaches downstream from Cabot Station and in the project bypass reach of Turners Falls Dam, in the Turners Falls Dam impoundment and in relation to Northfield Mountain Pump Storage operations, downstream and upstream of the Vernon Dam, and in the project area downstream of Bellows Falls Dam. The following objectives will address this request:

- Determine areas utilized by American shad for spawning by conducting night-time visual observation of spawning activity, identify and define areas geospatially, and obtain data on physical habitat conditions effected by project operations (e.g., water depth, velocity, discharge, substrate, exposure and inundation of habitats);

- Determine project operation effects on observed spawning activity, under a range of permitted or proposed project operation conditions;
- Quantify effects (e.g., water velocity, depths, inundation, exposure of habitats) of project operation on identified spawning areas for a range of conditions, over the complete period of spawning activity;
- Quantify spawning activity as measured by night-time spawning/splash surveys and egg collection in areas of spawning activity, and downstream of these areas, to further determine project operation effects (location extent of exposure from changing water levels and flows and on associated habitats from project operations).

If it is determined that the Project operations are adversely affecting the spawning activity of American shad and impacting spawning area habitat, identify operational regimes that will reduce and minimize impacts spawning habitat and spawning success within the project area. This study will require two years of field data to capture inter-annual variability to river discharge and water temperatures and to allow for evaluation of alternative flow regimes if year one studies determine that the present peaking regime negatively affects spawning.

Resource Management Goals

The requestor is not a public agency. However, we believe the information gathered as a result of this study would further regional resource management goals, and more specifically The Connecticut River Atlantic Salmon Commission's *Management Plan for American Shad in the Connecticut River.*

Public Interest

The Northfield Mountain Project and the Turners Falls Project and other projects in the upper Connecticut River alter flows, impacting aquatic species and communities and specifically American shad movement and spawning. Flow alterations caused by the cumulative effects of all projects in the Connecticut River affect the public's use of the river for recreation. Angling for shad is directly impacted by a reduced population caused by hydroelectric projects on the river.

Existing Information

Since the construction of the first fish lift facility at Holyoke Dam in 1967, American shad have had access to spawning and rearing habitat upstream from Holyoke Dam. A number of improvements to the Holyoke fishway have occurred since that time, but while the numbers of shad lifted at Holyoke have reached as much as 721,764 and the overall shad population to the river exceeded 1.6 million shad in 1992 (CRASC 1992), total shad population, and numbers of shad passing Turners Falls and Vernon Dam have not met CRASC management plan objectives. Population number and passage numbers past Holyoke have declined substantially from those totals in recent years, with average Holyoke passage numbers over the last 10 years of 211,850. Since historically approximately half of the returning population of shad to the river passed upstream of Holyoke, recent returns are far below management goals. Effective upstream and downstream passage and successful in-river spawning and juvenile production are necessary to help achieve shad management goals for the Connecticut River.

American shad broadcast spawn in congregations over shallow flats and rocky or sandy substrates (Davis et al, 1970, Mansuetti and Kolb 1953), at depths less than 10 feet and often far shallower with spawning fish swimming vigorously near the surface in a closely packed circle (Marcy 1972, Mackenzie et al 1985). Fertilized eggs drift downstream until hatching (Mackenzie et al 1985).

American shad are known to spawn downstream from the Turners Falls Project. Layzer (1974) identified 6 spawning sites from an area below the mouth of the Deerfield River (river mile 191.9) to river mile 161.7 below the Mill River in Hatfield, MA. Kuzmeskus (1977) verified 16 different spawning sites ranging from downstream of the Cabot tailrace to just upstream of the Holyoke dam (river mile 87.1). The only parameter that all spawning sites had in common was current (Kuzmeskus 1977). TU is not aware of any more recent studies that document whether these 16 sites are still viable spawning locations for shad. We are not aware of any studies that have determined American shad spawning habitat or spawning sites upstream of Vernon Dam to Bellows Fall Dam (historic extent of upstream range).

First Light Power conducted studies in the late spring and summer of 2012, examined habitat conditions downstream of the Turners Falls Dam. The study documented that in low flow conditions, Cabot Station project operations produced fluctuations in water level elevations that can range over 4 feet in magnitude (daily operation) at the USGS Montague Gage Station, to lower values of 2 to 3 feet at the Route 116 Bridge, Sunderland, MA (PAD). Similar short-term, limited monitoring in the upper Turners Falls Dam impoundment identified water level changes due to project operations that d cyclically varied several feet on a sub-daily frequency.

Project Nexus

American shad are known to spawn at five locations downstream from the Turners Falls Project from an area below the mouth of the Deerfield River (river mile 191.9) and ten other locations downstream to river mile 161.7 below the Mill River in Hatfield (Layzer 1974, Kuzmeskus 1977).

Shad spawning is likely influenced by river flow, which fluctuates greatly due to the project's peaking mode of operation. These fluctuations may impact shad spawning activity by altering current velocities and water depth at the spawning sites. Effects on spawning behavior could include suspension of spawning activity, poor fertilization, flushing of eggs into unsuitable habitat due to higher peaking discharges, eggs dropping out into unsuitable substrate and being covered by sediment deposition and/or eggs becoming stranded on dewatered shoal areas as peak flows subside.

While a number of shad spawning and egg deposition studies were conducted in the 1970s, that research was aimed at assessing the potential impact of developing a nuclear power station in the Montague Plains section of the Connecticut River. TU is not aware of any studies being conducted specifically designed to determine if a relationship between spawning behavior, habitat use, and egg deposition and project operations effects of the Turners Falls, Northfield Mountain Pump Storage and Vernon projects and downstream of Bellows Falls Dam..

TU is concerned that peaking operations may be altering spawning behavior and contributing to the failure of the Connecticut River shad population to meet management targets.

Proposed Methodology

The first year of study should examine a sample of known spawning areas downstream of the Turners Falls Dam project, to determine operation effects on shad spawning behavior, activity, and success. In areas upstream of Turners Falls Dam to the Bellow Falls Dam tailrace, the study should identify areas utilized for spawning by American shad. In the second year, should results from year one determine project operations affected spawning activity, access to habitat, or success, downstream of Turners Falls Dam, then an identical more detailed assessment (identified objectives) should be conducted in spawning areas upstream of Turners Falls Dam to the Bellows Falls Dam tailwater. Measures to reduce or eliminate any documented project operation impacts should be explored and evaluated in year two, downstream of Turners Falls Dam.

The impacts to spawning behavior would best be studied by night-time observations of actual in-river spawning behavior (Ross et al. 1993). Project discharge increases or decreases during actual observed spawning activity will provide empirical evidence of change in behaviors. The observational methodology should follow the protocol specified in Layzer (1974) and/or as described in Ross et al. (1993). The analysis should utilize the observational field data in conjunction with operational data from the projects (station generation and spill on a sub-hourly basis). To assess the impacts of changes in generation flows, the study should include scheduled changes in project operation to ensure that routine generation changes that occur during the nighttime spawning period affect downstream spawning habitats selected for study while shad are spawning. Stier and Crance (1985) provide optimal water velocities during spawning to range between 1 to 3 ft/sec.

In areas used for spawning, the characteristics of those areas (e.g., location, depth, flow, substrate) should be recorded. The effect of project operations (discharge, water velocity, inundation and exposure) should be assessed. Drift nets will be used to collect eggs to quantify egg production before and after flow changes at the spawning site.

In the reaches above the Turners Falls dam, night time observations of splashing associated with shad spawning should be done in each reach as sufficient numbers of shad are passed above each dam. Observations should be done regularly until the end of the spawning season. The use of radio-tagged adult shad from a separate Study Request will aid in this effort. An estimate of the total area used for spawning and an index of spawning activity should be recorded for each site.

These methods are consistent with previous studies and in the Connecticut River accepted practice.

Level of Effort and Cost

Neither First Light or TransCanada propose any studies to meet this need. Estimated cost for the study is expected to be moderate (up to $40,000) for each owner, with the majority of costs associated with fieldwork labor.

Literature cited:

Atlantic States Marine Fisheries Commission. 2010. Amendment #3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management). Washington, D.C.

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Layzer, J.B. 1974. Spawning Sites and Behavior of American Shad, *Alosa sapidissima* (Wilson), in the Connecticut River Between Holyoke and Turners Falls, Massachusetts, 1972. Master of Science Thesis. University of Massachusetts, Amherst, Massachusetts.

MacKenzie, C., L. Weiss-Glanz, and J. Moring. 1985. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (mid-Atlantic) American shad. U. S. Fish and Wildlife Service Biological Report No. 82 (11.37), Washington, D.C.

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Stier, D. J. and J. H. Crance. 1985. Habitat suitability index models and instream flow suitability curves: American shad. U. S. Fish and Wildlife Service Biological Report No. 82(10.88),Washington, D.C.

Requested Study No. 4
Evaluation of Timing of Downstream Migratory Movements of American Eels on the Mainstem Connecticut River
FERC No. 1904 & FERC No. 1855

Goals and Objectives

The goal of this study is to better understand migration timing of adult, silver-phase American eels as it relates to environmental factors and operations of mainstem hydropower projects on the Connecticut River.

The objectives of this study are:

1. Quantify and characterize the general migratory timing and presence of adult, silver-phase American eels in the Connecticut River relative to environmental factors and operations of mainstem river hydroelectric projects

Resource Management Goals

The requestor is not a public agency. However, we believe the information gathered as a result of this study would further regional resource management goals, and more specifically The Atlantic States Marine Fisheries Commission's management plans for American eel:

1. Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.
2. Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

In addition, the Connecticut River Atlantic Salmon Commission (CRASC) developed A Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin, 2005 whose implementation would be enhanced by the results of this study.

Public Interest

The Northfield Mountain Project and the Turners Falls Project and other projects in the upper Connecticut River alter flows, impacting aquatic species and communities and specifically American eel movement and habitat use. Flow alterations and barriers at hydroelectric projects thereby affect a public fishery resource.

Existing Information

Data on timing of downstream migratory movements and rates of American eels in the mainstem Connecticut River are sparse and relatively incomplete. Preliminary data on presence of "eel-sized" acoustic targets have been collected (Haro et al. 1998) within the Turners Falls Project's Cabot Station forebay that were somewhat confirmed by video monitoring at the Cabot Station downstream fish bypass; however, these were short-term studies, with acoustic monitoring only performed from 17 September to 5 October and video monitoring only conducted between 18 September to 22 October.

Some daily monitoring of the downstream bypass at the Holyoke Dam (canal louver array) was performed in 2004 and 2005 (Kleinschmidt, Inc. 2005, 2006, Normandeau Associates 2007); these studies also were of relatively short duration (spanning from October 5 to November 10 in 2004 and September 9 to November 11 in 2005) and the sampler was only operated at night.

To date, no other directed studies of eel migratory movements have been conducted at any location on the Connecticut River mainstem. This information gap needs to be filled, as it relates directly to when downstream passage and protection measures need to be operated.

We also note that within the past seven years, the U.S. Fish and Wildlife Service has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005 the Service issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability (CESAR). On September 29, 2011 the Service issued a substantial 90-day finding and initiated a 12-month status review. The Service is still accepting new American eel information for the ongoing status review. The Service also is currently in settlement negotiations with CESAR on their legal complaint that the Service failed to complete the 12-month finding within the statutory timeframe. Although the date for completion of the Service's 12-month finding on the latest petition is uncertain, it is likely that it will be made prior to any new licenses are issued for the projects.

Project Nexus

The timing of downstream migration of adult eels is poorly defined for the Connecticut River; therefore the general effects of hydroelectric project operations on eel survival to the ocean are unknown. Although separate study requests have been submitted to address project-specific downstream passage route selection, delays, and mortality of eels, general characteristics of river flow and environmental conditions may have significant relationships with project operation and eel migratory success and survival. For example, eels may tend to move immediately before or during periods of significant precipitation (or consequently river flow); times at which projects may be generating at maximum capacity or spilling, which may (or may not) present a higher passage risk to eels. Conversely, periods of low flow may be associated with a significant proportion of total river flow passing through turbine units, which present additional (or different) passage risk to eels. If discrete conditions which promote eel downstream migration are known, it may be possible to take actions with respect to project operations which reduce or minimize passage risk; i.e., operation of a bypass, reduction of intake approach velocities, directed spillage through a “safe” route, etc. These studies should provide baseline information on river-specific downstream migration to predict when silver-phase eels are expected to be migrating in the mainstem Connecticut River, from which project operations could be modified to minimize passage risks.

The studies are proposed for a single or multiple sites; the results will be relevant to all sites on the Connecticut River mainstem.

Proposed Methodology

Quantification of downstream movements of American eels in river systems requires systematic sampling of migrants throughout the migratory season. This can be accomplished with traditional active trapping methods; i.e., fyke or stow net sampling, weirs, or eel racks, but these methods are technically challenging on larger mainstem rivers, due to the scale of flows that need to be sampled, difficulties in operation throughout all flow conditions, and high debris loading during fall flows. Passive monitoring of migrant eels using hydroacoustic methods offers an alternative to active trapping. However, passive monitoring requires verification of potential acoustic targets with some level of active (collection) or visual (traditional optical or acoustic video) sampling.

Two potential locations offer opportunities to conduct simultaneous passive and active sampling: the Cabot Station (Turners Falls project) canal/forebay and the Holyoke Dam forebay and canal louver/bypass system. Each location possesses a route of downstream passage which conducts a significant proportion of river flow (Cabot canal and Holyoke forebay or canal), and each has a proximal bypass equipped with a sampler so that fish can be concentrated/collected from the passage route and identified to species. Project operations do influence the relative proportion of flow (and thus numbers of downstream migrant eels) in each passage route, so numbers of eels sampled in each route represent only a proportion of the total number of eels migrating downstream within the entire river. Because the absolute proportion of eels using a specific route at any one time is unknown, numbers of eels quantified within a route must serve as a relative index of the degree of migratory movement.

This study shall quantify eel movements in either one, or preferably both, locations for two consecutive years (since environmental conditions strongly influence migratory timing of eels, which can vary significantly from year to year; Haro 2003). Eels will be quantified using methods similar to Haro et al. (1999), by continuously monitoring a fixed location at the projects with hydroacoustics. Because eels tend to concentrate in areas of dominant flow (Brown et al. 2009, EPRI 2001), the zone to be monitored should pass a dominant proportion of project flow throughout most periods of operation (i.e., forebay intake area). Hydroacoustic monitoring shall encompass the entire potential migratory season, beginning in mid-August and ending in mid-December, and shall operate 24 hours per day. Data will be recorded for later processing and archiving.

Systematic active quantification of eels at downstream bypass samplers shall be performed simultaneously with passive hydroacoustic monitoring, to verify presence of eels and relative abundance of eel-sized hydroacoustic targets from the hydroacoustic data. Although daily operation of the bypass sampler could be performed, a more comprehensive technique is to monitor eels entering the bypass with an acoustic camera (i.e. DIDSON, BlueView, etc.). The acoustic camera will afford positive visual identification of eels as they enter the bypass, which is a concentration point for migrating eels. Acoustic camera monitoring will also allow monitoring to be performed 24 hours a day, and will be relatively unaffected by water turbidity (which influences effectiveness of traditional optical video monitoring). The acoustic camera system will be operated during the same time period as acoustic monitoring, and images will be recorded for later processing and archiving.

Data analyses of hydroacoustic, acoustic camera, bypass sampling, and environmental/ operational data will follow standard methodology.

Project operation (flows, levels, gate openings, number of units operating and operation level) and environmental conditions (river flow, temperature, turbidity, air temperature, precipitation) will be monitored regularly (hourly measurements if possible) throughout the duration of the studies.

These methodologies are consistent with common and accepted practice.

Level of Effort and Cost

The level of cost and effort for the downstream migrant eel migratory timing study would be moderate, given the level of cost for instrumentation, deployment, and data review/analysis. Cost is estimated at $50,000 per year for the study.

The applicant did not propose any studies to meet this need in the PAD.

Literature cited:

Brown, L.S. 2005. Characterizing the downstream passage behavior of silver phase American eels at a small hydroelectric facility. M.Sc. Thesis, Department of Natural Resource Conservation, University of Massachusetts, Amherst, Massachusetts. 110 pp.

Brown, L., A. Haro, and T. Castro-Santos. 2009. Three-dimensional movement of silver-phase American eels in the forebay of a small hydroelectric facility. Pages 277-291in: J. Casselman et al. editors. Eels at the Edge: Science, Status, and Conservation Concerns. American Fisheries Society, Bethesda, MD.

EPRI (Electric Power Research Institute). 2001. Review and documentation of research and technologies on passage and protection of downstream migrating catadromous eels at hydroelectric facilities. EPRI Technical Report No. 1000730, Palo Alto, California 270 pp.

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Kleinschmidt, Inc. 2005. Factors influencing the timing of emigration of silver-phase American Eels, *Anguilla rostrata*, in the Connecticut River at Holyoke MA. Submitted to the City of Holyoke Holyoke Gas and Electric Department. 27 pp.

Kleinschmidt, Inc. 2006. Holyoke Project (FERC No. 2004) silver-phased American eel flow priority plan. Submitted to the City of Holyoke Holyoke Gas and Electric Department. 51 pp.

Normandeau Associates, Inc. 2007. American eel emigration approach and downstream passage routes at the Holyoke Project, 2006. Submitted to the City of Holyoke Holyoke Gas and Electric Department. Final report. Normandeau Associates, Inc., Westmoreland, New Hampshire. 81 pp.

Requested Study No. 5
American Eel Survey Upstream of the Vernon and Bellows Falls dams
FERC No. 1904 & FERC No. 1855

Goals and Objectives

The goal of this study is to provide baseline data relative to the presence of American eel upstream of the Vernon, Bellows Falls, and Wilder dams.

The objective of the study is to determine the relative abundance and distribution of American eel upstream of the Vernon, Bellows Falls and Wilder dams in both riverine and lacustrine habitat.

Resource Management Goals

The requestor is not a public agency. However, we believe the information gathered as a result of this study would further regional resource management goals, and more specifically The Atlantic States Marine Fisheries Commission's management plans for American eel:

1. Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.
2. Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

In addition, the Connecticut River Atlantic Salmon Commission (CRASC) developed A Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin, 2005 whose implementation would be enhanced by the results of this study.

Public Interest

The Northfield Mountain Project and the Turners Falls Project and other projects in the upper Connecticut River alter flows, impacting aquatic species and communities and specifically American eel movement and habitat use. Flow alterations and barriers at hydroelectric projects thereby affect a public fishery resource.

Background and Existing Information

According to the PADs, very few American eels were collected in the Fish Assemblage and Habitat Assessment of the Upper Connecticut River (Yoder et al., 2009). In the

Vernon Project area upstream of the dam, only one eel was collected; no eels were collected from the Bellows Falls pool, and none were found upstream of the Wilder Dam. However, in 2012 over 200 eels were documented using the upstream fish ladder at the Vernon Project and the New Hampshire Fish and Game Department has observed eels upstream of the Bellows Falls and Wilder dams. More recently, eels have been observed in Lake Morey, Vermont, which is located upstream of Wilder Dam (Lael Will, VDFW, personal communication). Therefore, while it is clear that some eels are passing all three dams (Vernon, Bellows Falls, and Wilder), it remains unknown how many eels may be rearing in the mainstem habitat upstream of the dams or in tributaries and lakes and ponds that feed into the mainstem river.

No targeted eel surveys have been conducted to determine the abundance and distribution of American eels in riverine and lacustrine habitat upstream of the three projects. This information gap needs to be filled so resource agencies can evaluate properly the need for, and timing of, downstream passage and protection measures for outmigrating silver phase eels.

We also note that within the past seven years, the U.S. Fish and Wildlife Service has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005 the Service issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability (CESAR). On September 29, 2011 the Service issued a substantial 90-day finding and initiated a 12-month status review. The Service is still accepting new American eel information for the ongoing status review. The Service also is currently in settlement negotiations with CESAR on their legal complaint that the Service failed to complete the 12-month finding within the statutory timeframe. Although the date for completion of the Service's 12-month finding on the latest petition is uncertain, it is likely that it will be made prior to any new licenses are issued for the projects.

Project Nexus

The project configurations present problems with respect to providing safe, timely and effective passage for outmigrating eels. The intakes are deep and, while no specification for the trashracks were provided in the PADs, it is unlikely that they would prevent impingement and/or entrainment of eels. Existing anadromous downstream passage facilities at the projects also would not be expected to be effective for eels; the target anadromous species are surface-oriented, while eels tend to move much deeper in the water column. If eels are utilizing habitat upstream of the dams, then appropriate protection and downstream passage measures will be needed.

In order to understand the need for, and timing of, downstream eel passage at the projects, we are requesting that TransCanada undertake eel surveys in the Connecticut River upstream of the three dams and in tributaries feeding into the mainstem river within the project areas. Surveying tributary habitat is necessary because surveying the mainstem alone may lead to an underestimation of eel abundance, particularly if there are relatively short tributary streams that lead to a lake or pond (where eels may accumulate, leading to true high densities).

Proposed methodology

TU requests an eel survey be conducted in the mainstem river an tributaries upstream from the three projects. The methodology should be similar to that used in the relicensing of the Saluda Hydroelectric Project, FERC No. 516 (Appendix A), the eel assessment for the Merrimack River completed by the Service's Central New England Fishery Resources Office (Appendix B), and the proposed study plan for the relicensing of the Eastman Falls Project (FERC No. 2457).

In general, a combination of electroshocking (backpack in wadeable rivers and boat-mounted in larger rivers and lakes) and eel pots should be used to collect eels and determine catch rates. Sampled habitat should include: the mainstem Connecticut River from upstream of Vernon Dam to below the Ryegate Dam; tributaries to the Connecticut within that stretch where eels have been collected previously; and lakes and ponds (such as, but not limited to, Spofford Lake and Lake Morey), where eels have been collected previously. Sampling should occur during the summer (July through September).

Level of effort and cost

The expected level of effort and anticipated costs will be comparable to that experienced on similar FERC projects of this size. A study plan recently submitted for the Eastman Falls Project (FERC No. 2457) on the Pemigewasset River in New Hampshire, which is utilizing a similar methodology, estimated that sampling a nine-mile-long impoundment with shocking and eel pots would cost $25,000. They estimated the effort to be two nights for the electrofishing survey. Given the much larger area that will need to be sampled under this request, we estimate moderate cost and effort will be required (20 days of shocking mainstem habitat plus another 5-10 days for tributaries and associated lake/pond habitat).

Literature Cited

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & WildlifeDepartment.Waterbury,Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm. (Accessed September 10, 2012).

Requested Study No. 6
Study Request: Downstream American Eel Passage Assessment at Vernon and Bellows Falls
FERC No. 1904 & FERC No. 1855

Goals and Objectives

The goal of this study is to determine the impact of three hydroelectric projects on the outmigration of silver eels in the Connecticut River. Entrainment at the conventional turbines at the Vernon, Bellows Falls, and Wilder projects can result in mortality or injury. It is important to understand the passage routes at each project and the potential for delay, injury, and mortality to assess alternative management options to increase survival.

The objectives of this study are:

1. Quantify the movement rates (including delays) and relative proportion of eels passing via various routes at the projects (i.e. through the turbines, through the downstream bypasses; spilled at the dams, etc.).
2. Evaluate instantaneous and latent mortality and injury of eels passed via each potential route.

Resource Management Goals

The requestor is not a public agency. However, we believe the information gathered as a result of this study would further regional resource management goals, and more specifically The Atlantic States Marine Fisheries Commission's management plans for American eel:

1. Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.
2. Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

In addition, the Connecticut River Atlantic Salmon Commission (CRASC) developed A Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin, 2005 whose implementation would be enhanced by the results of this study.

Public Interest

The Vernon Project and the Bellows Falls Projects and other projects in the upper Connecticut River alter flows, impacting aquatic species and communities and specifically American eel movement and habitat use. Flow alterations and barriers at hydroelectric projects thereby affect a public fishery resource.

Existing Information

The PAD contains information on the biology and life history of the American eel. It also summarizes eel collection data within the Vernon and Bellows Falls project areas. Eels have been collected both upstream and downstream of the Vernon Project and also have been counted passing the upstream anadromous fish ladder. Eels also have been documented upstream of the Bellows Falls and Wilder projects.

To date, no directed studies of eel entrainment or mortality have been conducted at any of the projects. These information gaps need to be filled so resource agencies can assess the relative and cumulative impact of project operations on outmigrating eels and develop adequate passage and protection measures to meet management goals and objectives.

We also note that within the past seven years, the U.S. Fish and Wildlife Service has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005 the Service issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability (CESAR). On September 29, 2011 the Service issued a substantial 90-day finding and initiated a 12-month status review. The Service is still accepting new American eel information for the ongoing status review. The Service also is currently in settlement negotiations with CESAR on their legal complaint that the Service failed to complete the 12-month finding within the statutory timeframe. Although the date for completion of the Service's 12-month finding on the latest petition is uncertain, it is likely that it will be made prior to any new licenses are issued for the projects.

Nexus to Project Operations and Effects

The Vernon, Bellows Falls, and Wilder projects operate as peaking facilities, except during periods when inflow exceeds the hydraulic capacities of the stations. Silver eels outmigrate during the mid- summer through late fall, a time of year when flows are generally within the operating capacities of the stations. Therefore, the projects would be expected to spill infrequently during the silver eel outmigration.

The project configurations present problems with respect to providing safe, timely and effective passage for outmigrating eels. The intakes likely are deep and, while no specification for the trashracks were provided in the PADs, it is unlikely that they would prevent impingement and/or entrainment of eels. Existing anadromous downstream passage facilities at the projects also would not be expected to be effective for eels; the target anadromous species are surface-oriented, while eels tend to move much deeper in the water column. Eels are known to occur upstream of the dams; therefore, it is necessary to understand how eels move through the projects and the level of injury or mortality caused by entrainment through the projects’ turbines.

Methodology Consistent with Accepted Practice

In order to understand the movements of outmigrating silver eels as they relate to operations at the Vernon, Bellows Falls, and Wilder projects, radio telemetry technology should be utilized. Radio telemetry is an accepted technology that has been used for a number of studies associated with hydropower projects, including at the Muddy Run Project (FERC No. 2355).

Studies should be designed to investigate route selection (i.e., entrainment vs. spill) independently from estimation of mortality/injury, because these metrics require different telemetric methodologies. Studies also will likely benefit from data collected over both study years (especially route selection studies, which may be more significantly affected by environmental conditions during a given season that mortality/injury studies). It is also envisioned that results from route selection studies can guide design of turbine mortality studies. Therefore, it is proposed, at a minimum, that route selection studies be conducted in multiple years, but mortality/injury studies may be conducted after the first year of route selection studies has been completed.

1. Objective 1: Route Selection

This study will involve systematic releases of radio-tagged silver phase eels at strategic points above areas of interest, to assess general routes of passage (i.e., via spill, bypass, or turbines). Active downstream migrants should be collected within-basin if possible (i. e., Cabot or Holyoke bypass samplers), but fish sourced from out of basin may be acceptable to meet sample size demands. Experimental fish must meet morphometric (e.g. eye diameter relative to body size) criteria to ensure they are migrant silver phase. Collections should be made within the migratory season (late Aug to mid Oct), and eels should be tagged and released within 21 days after capture, but preferably within seven days (particularly if the test eels are from out-of-basin).

All telemetered eels will be radio and passive integrated transponder (PIT) tagged. PIT antennas will be installed at bypasses at Vernon and Bellows Falls and monitored continuously to verify passage of eels via bypass channels.

Vernon Project Route Selection Study:

A minimum number of 50 telemetered eels (e.g., 5 separate groups of approximately 10 eels each) will be required to maximize the data return. Tagged eels should be released at least 5 km upstream of the Vernon project. Groups of eels should be released during spill and non-spill periods if possible. Telemetry receivers and antennas should be located to assess passage via the following potential routes: Vernon spillway; Fishway attraction water intake (if operational); Vernon downstream bypasses; and Vernon Station turbines.

Eels from the Bellows Falls route studies migrating to the Vernon Dam may be used to supplement (but not serve in lieu of) these release groups.

Bellows Falls Dam Route Selection Study:

A minimum number of 50 telemetered eels (e.g., 5 separate groups of approximately 10 eels each) will be required to maximize the data return. Groups of eels should be released during spill (if any) and non-spill and during periods of low, moderate, and high generation conditions, if possible. Tagged eels should be released at least 5 km upstream of the Bellows Falls Dam. If significant spillage occurs during releases, up to 50 additional eels should be released in the upper canal and allowed to volitionally descend through the canal to assure that sufficient number of eels are exposed to canal and powerhouse intake conditions. Telemetry receivers and antennas should be located upstream and downstream of the spillway, at the canal entrance, within the canal, in the fish downstream fish bypass entrance and turbine intakes and in mainstem below Bellows Falls Station to assess passage via the following potential routes: entrainment into the canal; passage over the spillway; into the upstream fishway attraction water intake (this should operated during the study to assess its use by eels as it may be operational in the future for riverine or eel passage as addressed in the Resident Fish Passage study request); the downstream fish bypass; and station turbines.

Eels from the Wilder route study migrating to the Bellow Falls Project may be used to supplement (but not serve in lieu of) these release groups.

<u>Wilder Project Route Selection Study:</u>
A minimum number of 50 telemetered eels (e.g., 5 separate groups of approximately 10 eels each) should be required to maximize the data return. Tagged eels should be released at least 5 km upstream of the Wilder Project. Groups of eels should be released during spill and non-spill periods if possible. Telemetry receivers and antennas should be located to assess passage via the following potential routes: Wilder spillway; Fishway attraction water intake (if operational); Wilder downstream bypasses; and Wilder Station turbines.

Mobile tracking (i.e., via boat) in river reaches between release sites and several km downstream of Vernon Station will be performed at regular intervals during and after releases to confirm routes and fates of passed fish, or fish lost to follow-up.

Movement rates (time between release and detection at radio antenna locations, and between radio antenna locations) of eels passing the projects by various routes will also be quantified.

The route selection portion of this study should occur in both study years.

2. **Objective 2: Spill, Bypass, and Turbine Mortality/Injury Studies**
Spill, bypass, and turbine mortality will be assessed using a radio-telemetric balloon tag method. A minimum number of 50 tagged eels (e.g., 5 separate groups of approximately 10 eels each) will be required at each location (dam spillways, downstream bypasses, and station turbines) to maximize the data return.

For spill mortality sites (dam spillways and downstream bypasses), tagged eels will be injected or released into spill flow at points where water velocity exceeds 10 ft/sec, to minimize the possibility of eels swimming upstream into the headpond or canal. Passed balloon-tagged eels will be recovered below areas of spill and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged eels will be censored from the data.

For turbine mortality sites (Vernon, Bellows Falls, and Wilder stations), tagged eels will be injected into intakes of units operating at or near full generation at points where intake water velocity exceeds 10 ft/sec, to minimize the possibility of eels swimming back upstream through the intakes. Passed balloon-tagged eels will be recovered in the tailrace and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged eels will be censored from the data.

If the balloon tag mortality component of the study occurs in Study Year 1 then all possible route selection sites would need to be evaluated. If the balloon tag mortality component of the study occurs in Study Year 2, then results from the route selection study (Year 1) could be used to inform which sites need to be evaluated for mortality.. Eels recovered from balloon tag studies should not be used for route selection studies.

Data analyses of route selection and turbine mortality (instantaneous and latent) will follow standard methodology.

Project operation (flows, levels, gate openings, number of units operating and operation level) and environmental conditions (river flow, temperature, turbidity, air temperature, precipitation) will be monitored regularly (hourly measurements if possible) throughout the duration of the studies.

These methodologies are consistent with accepted practice.

Level of Effort/Cost, and Why Alternative Studies will not suffice

The level of cost and effort for the downstream eel passage study would be moderate to high; silver eels would need to be collected, tagged, and released in several locations over the course of the migration season. Antennas and receivers would need to be installed at the intakes of all stations as well as at the dam spillways and Station bypasses, and monitored regularly. Data would need to be retrieved periodically, then analyzed. A multi-site route selection study conducted by the USGS Conte Lab on the Shetucket River in Connecticut cost approximately $75,000 for the first year of study. Costs are estimated at $100,000 per year for the Route Selection studies and $75,000 per year for the Spill, Bypass, and Turbine Mortality/Injury Studies, for each project.

The applicant did not propose any studies to meet this need in the PAD.

Literature cited:

Brown, L.S. 2005. Characterizing the downstream passage behavior of silver phase American eels at a small hydroelectric facility. M.Sc. Thesis, Department of Natural Resource Conservation, University of Massachusetts, Amherst, Massachusetts. 110 pp.

Brown, L., A. Haro, and T. Castro-Santos. 2009. Three-dimensional movement of silver-phase American eels in the forebay of a small hydroelectric facility. Pages 277-291in: J. Casselman et al. editors. Eels at the Edge: Science, Status, and Conservation Concerns. American Fisheries Society, Bethesda, MD.

EPRI (Electric Power Research Institute). 2001. Review and documentation of research and technologies on passage and protection of downstream migrating catadromous eels at hydroelectric facilities. EPRI Technical Report No. 1000730, Palo Alto, California 270 pp.

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department.Waterbury,Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm. (Accessed September 10, 2012).

Requested Study No. 7
Model River Flows and Water Levels Upstream and Downstream from the Wilder, Bellows Falls, and Vernon Stations and Integration of Project Modeling with Downstream Project Operations
FERC No. 1904 & FERC No. 1855

Goals and Objectives

The goal of this study is to develop river flow models that permit the evaluation of the hydrologic changes to the river caused by the physical presence and operation of the Wilder, Bellows Falls, and Vernon Hydroelectric Projects and the interrelationships between the operation of all five hydroelectric projects up for relicensing and river inflows. Specific objectives of this study include:

1. Conduct quantitative hydrologic modeling of the hydrologic influences and interactions that exist between the water surface elevations of the Wilder, Bellows Falls, and Vernon project impoundments and discharges from the Wilder, Bellows Falls, and Vernon projects and the downstream hydroelectric projects including:
    a. Inflows into the Wilder, Bellows Falls, and Vernon impoundments from the Fifteen Mile Falls Project, FERC No. 2007, and other sources;
    b. Existing and potential discharges from the Wilder, Bellows Falls, and Vernon project generating facilities and spill flows, including existing and potential minimum flow and other operational requirements;
    c. Existing and potential water level fluctuation restrictions (maximum and minimum pond levels) of the Wilder, Bellows Falls, and Vernon impoundments, and consequent changes in downstream project discharges; and

   d. Incorporation of the potential effects of climate-altered flows on project operations over the course of the license.
2. Assess how existing and potential operations of the Wilder, Bellows Falls, and Vernon projects affect the operations of the Northfield Mountain and Turners Falls Projects, including:
   a. How Wilder, Bellows Falls, and Vernon flow fluctuations affect pool levels of the Turners Falls impoundment; and
   b. How operations of the Wilder, Bellows Falls, and Vernon projects affect Turners Falls discharges.

Resource Management Goals

The requestor is not a public agency. However, we believe the information gathered as a result of this study would further regional resource management goals of protecting and conserving aquatic species (including the federally endangered shortnose sturgeon) and their habitats. Specifically:

- Protect, enhance, or restore, diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
- Provide an instream flow regime that meets the life history requirements of resident and migratory fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
- Minimize current and potential negative project operation effects on water quality and aquatic habitat.

Public Interest

Migratory and riverine fish have an important ecological role as well as recreational and angling opportunities. A full assessment of the impacts of hydrogenation will benefit a public resource with better information for management of flows to protect these resources.

Existing Information

Available information in the PAD does not indicate how project operations have altered the hydrology downstream from each of these facilities, which may affect resident and migratory fish, macroinvertebrates, rare, threatened and endangered species, aquatic plants and other biota and natural processes in the Connecticut River. It is also unclear how operations at one facility affect the operations at another.

Nexus to Project Operations and Effects

The Wilder, Bellows Falls, and Vernon projects are each currently operated with required minimum flows of 675, 1,083, and 1,250 cfs (or inflows if less) for each facility, respectively, though in practice minimum flows are operated as 700, 1300, and 1600 cfs, respectively. There is presently no required minimum flow for the bypassed reach of the Bellows Falls Project. Each of the projects operates as a daily peaking facility, such that "Generation can vary during the course of any day between the required minimum flow and full capacity if higher flows are available" (p. 2-28, p. 2-29, and p. 2-30 in the Wilder, Bellows Falls and Vernon PADs, respectively). Total hydraulic capacity of each facility is 12,700, 11,010, and 12,634 cfs, respectively. Regular daily fluctuations on the order of 9,000 cfs or greater are commonly recorded at USGS gages 01144500 (Connecticut River at West Lebanon, below Wilder Dam) and 01154500 (Connecticut River at North Walpole, NH, below Bellows Falls Dam). Daily fluctuations in headpond elevation are approximately 2.5' (382' to 384.5' MSL), 1.2' (289.9' to 291.1' MSL), and 1.2' (218.6' to 219.8' MSL) at the Wilder, Bellows Falls, and Vernon impoundments, respectively.

These described changes affect biotic habitat and biota upstream and downstream of each project. Project operations and potential changes to operations to mitigate impacts at each facility are influenced by inflows and operations of upstream projects. Results of river flow analyses will provide necessary information regarding changes that can be made to the Wilder, Bellows Falls, and Vernon Project flow releases and/or water level restrictions, how such changes may be constrained by inflows and upstream project operations, and how these changes potentially affect downstream resources. This information will then be used to develop flow-related license requirements and/or other mitigation measures.

Methodology Consistent with Accepted Practice

River hydrology statistics and hourly flow modeling are commonly employed at hydroelectric projects to assess implications of project operations on the river environment.

Level of Effort/Cost, and Why Alternative Studies will not suffice

Level of effort and cost of model development are expected to be moderate as much of the baseline modeling has already been completed, but running of various scenarios through the model(s) will be needed throughout the relicensing process to assess the implications of changes to the operations of each project on other projects and other resources. The modeling exercise will also require coordination and cooperation between TransCanada and the downstream licensee to assure that the model inputs and outputs can be accurately related.

We would anticipate that the expected level of effort and anticipated costs will be comparable to that experienced on similar FERC relicensing projects of this size.

Requested Study No. 8
Upstream American Eel Passage Assessment at Vernon and Bellows Falls Projects
FERC No. 1904 & FERC No. 1855

Goals and Objectives

This study has two objectives:

1. Conduct systematic surveys of eel presence/abundance at tailrace and spillway locations at the Vernon, Bellows Falls, and Wilder projects to identify areas of concentration of eels staging in pools or attempting to ascend wetted structures that would potentially establish the most effective locations to place upstream eel passage facilities.
2. Collect eels with temporary trap/pass devices from areas identified from surveys as potential locations of eel concentration to assess whether eels can be collected/passed in substantial numbers, and whether locations are viable sites for permanent eel trap/pass structures.

Resource Management Goals

The requestor is not a public agency. However, we believe the information gathered as a result of this study would further regional resource management goals, and more specifically The Atlantic States Marine Fisheries Commission's management plans for American eel:

1. <u>Interstate Fishery Management Plan for American Eel</u>. April 2000. Atlantic States Marine Fisheries Commission.
2. <u>Addendum II to the Fishery Management Plan for American Eel</u>. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

In addition, the Connecticut River Atlantic Salmon Commission (CRASC) developed <u>A Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin</u>, 2005 whose implementation would be enhanced by the results of this study.

Public Interest

The Bellows Falls Project and the Vernon Projects and other projects in the upper Connecticut River alter flows, impacting aquatic species and communities and specifically American eel movement and habitat use. Flow alterations and barriers at hydroelectric projects thereby affect a public fishery resource.

Existing Information

The PAD contains no information relative to areas where eels seeking to move upstream concentrate downstream of the three dams, or annual numbers of eels attempting to ascend past the dams. While eels have been known to ascend the Vernon and Bellows Falls fish ladders, their efficiency for passing eels is unknown, and they are only operated during the American shad passage season (from April 15 through July 15). Eels are currently able to pass Vernon, Bellows Falls, and Wilder dams (as evidenced by documented presence of eels upstream), but the total number of eels attempting to pass all three dams and the proportion successfully passing each project is unknown (but suspected to be low). The downstream Holyoke Project has operated upstream eel passage facilities since 2004. Last year these facilities passed over 40,000 juvenile eels. While the next dam upstream (the Turners Falls Project; FERC No. 1889) has no dedicated upstream eel passage facilities, eels have been known to ascend the Cabot Station fish ladder (A. Haro, U.S. Geological Survey, pers. comm.). Although there is rearing habitat in between the Turners Falls and Vernon dams, some eels will attempt to continue upstream, and passage needs to be provided so these fish can access historical habitat.

These information gaps need to be filled so resource agencies can determine the best locations to site upstream eel passage facilities and assess whether operating the existing anadromous ladders would be an effective mechanism to move juvenile eels upstream past the projects.

We also note that within the past seven years, the U.S. Fish and Wildlife Service has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005 the Service issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability (CESAR). On September 29, 2011 the Service issued a substantial 90-day finding and initiated a 12-month status review. The Service is still accepting new American eel information for the ongoing status review. The Service also is currently in settlement negotiations with CESAR on their legal complaint that the Service failed to complete the 12-month finding within the statutory timeframe. Although the date for completion of the Service's 12-month finding on the latest petition is uncertain, it is likely that it will be made prior to any new licenses are issued for the projects.

Project Nexus

The three projects generate hydropower on the head created by the Vernon, Bellows Falls, and Wilder dams. These dams create barriers to upstream migrating eels. While some eels are able to pass dams, some are not, and the passability of a given dam depends on factors such as its height, hydraulics, presence of climbable surfaces, presence of predators, risk of exposure to heat or drying while climbing a dam, etc. All three dams are high (Vernon: 58 ft. high; Bellows Falls: 30 ft. high; and Wilder: 60 ft. high), and the majority of the dam faces are dry during most of the upstream eel passage season. Design of the dams is not currently amenable to passage of eels by climbing. As mentioned earlier, the existing anadromous passage facilities are not designed to pass eels, and even if some eels are able to ascend the ladders, they may incur delays (in attraction or passage rates), be size-selective (e.g. velocity barrier for small eels presented by ~8 ft/sec flow through weirs and orifices), present a potential predation risk (predators in or near the fishways), and are not operated throughout the upstream eel passage season.

Proposed Methodology

1. Objective 1: Systematic Surveys
   Surveys of eel presence and relative abundance should be conducted at regular intervals throughout the eel upstream migratory season (~1 May to ~15 October, or when river temperatures exceed 10 C). Surveys should consist of visual inspection and trapping in likely areas where eels may concentrate as they attempt to climb structures wetted by significant spill or leakage flow below the dams and associated structures. These locations include: the upstream fish ladders at all three projects (dewatered state) and leakage or overflow points along the

downstream faces of all three dams, including spillways. Methods should include visual surveys (on foot, from a boat, or snorkeling) and trapping using small mesh (< 1/8" clear opening) baited eel pots. Visual surveys should be performed once per week, at night, preferentially during precipitation events. Trap sets should be performed once per week, with an overnight soak time. Recorded data should include location, observation of eels (presence, absence, relative numbers, relative sizes, behaviors, time/date of observation), and survey method.

2. Objective 2: Trap/Pass Collections
   Areas identified from Systematic Surveys as having significant number of eels present should be targeted as potential areas for permanent eel trap/passes, and should be initially assessed using temporary/portable trap passes. At a minimum (regardless of survey results), temporary trap passes should be installed at stilling basins and/or lower sections of fishways supplied with minimal attraction flow (0.5-1.0 cfs) during dewatered conditions at all three projects , as these locations may be supplemented with additional attraction flow and have high potential for being concentration points for upstream migrant eels. Similarly, traps should also be placed at spillway or bypass channel locations where eels have a potential to climb wetted (e.g., via leakage) flow zones, at the highest points where eels are able to climb to, or where otherwise feasible. Temporary trap/passes should be purpose-designed and built for each location, and operated throughout the eel upstream migratory season (~1May to 15 October, or when river temperatures exceed 10° C). Ramp-type traps with supplementary attraction flow are preferred temporary trap/pass designs. Traps should operate daily, with catches quantified every 2-3 days. Recorded data should include location, trapping interval, absolute numbers of eels trapped, relative eel sizes, and hydraulic and environmental conditions during the trapping period.

All collected eels from surveys should be released at their point of capture; those eels collected from trap/pass collections should be transported to and released into the headponds upstream of where they were collected.

These methodologies are consistent with accepted practice.

Level of Effort and Cost

The level of cost and effort for the survey component of the study would be low for each individual project (moderate for all three projects combined); a minimal number of personnel may be able to conduct the weekly surveys. The trap/pass component would require low to moderate cost and effort. We estimate $40,000 per project to conduct this study.

TU is not aware of any previously conducted or ongoing studies related to upstream eel passage. The applicant did not propose any studies to meet this need in the PAD.

Literature Cited

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department.Waterbury,Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm. (Accessed September 10, 2012).

Requested Study No. 9
Impact of Vernon Project Operations on Downstream Migration of Juvenile American Shad
FERC No. 1904

Conduct a field study of juvenile American shad outmigration at the Vernon Dam to determine if project operations negatively impact juvenile shad survival and production.

Goals and Objectives

Determine if project operations affect juvenile American shad outmigration survival, recruitment, and production. The following objectives will address this request:

- Assess project operation effects of Vernon Dam on the timing, routes, migration rates, and survival of juvenile shad;
- Determine the proportion of juvenile shad that as a downstream passage route choose or are directed to existing downstream bypass structures, gate structures, or are entrained into the station turbines and assess delay, survival, timing, and related impacts with these locations under a full range of operational conditions, over the period of outmigration;
- Determine survival rates for juvenile shad entrained into Vernon Station units.

If it is determined that the project operations or related effects are adversely affecting juvenile shad survival, migration timing, or other deleterious population effects are noted, identify operational solutions or other solutions that will reduce and minimize impacts, within the project affected area. This study will require two years of field data to capture inter-annual variability of river discharge, water temperature, and variability in run size and juvenile production (and timing of developmental stages) and variability in outmigration timing which may relate to spring, summer and fall conditions.

Resource Management Goals

The requestor is not a public agency. However, we believe the information gathered as a result of this study would further regional resource management goals, and more specifically The Connecticut River Atlantic Salmon Commission's *Management Plan for American Shad in the Connecticut River.*

Public Interest

The Vernon Project and other projects in the upper Connecticut River alter flows and entrain fish impacting aquatic species and communities and specifically juvenile American shad movement and survival. Flow alterations and entrainment caused by the cumulative effects of all projects in the Connecticut River affect the public's use of the river for recreation. Angling for shad is directly impacted by a reduced population caused by hydroelectric projects on the river.

Existing Information

Adult shad are counted annually as they pass above the Vernon Dam. Juvenile American shad production has been monitored upstream of the Vernon Dam and immediately downstream of that dam by Vermont Yankee Nuclear as part of an annual monitoring program using both boat electrofishing (since 1991) and beach seining (since 2000). A seasonal average annual index of juvenile American shad standing crop in Vernon reservoir has been calculated since 2000. Estimates of juvenile shad growth rates in the Vernon impoundment have been calculated annually beginning in 2004, and also in a study conducted in 1995 (Smith and Downey 1995).

Although there were numerous studies of downstream passage facilities at the Vernon Project for Atlantic salmon smolts, studies passage studies for American shad were limited to tests in 1991 and 1992 of a high frequency sound field to guide fish to te fish pipe, the primary downstream fishways in 1991 and 1992 (RMC 1993). Although the studies were deemed incomplete, the technology indicated some level of response by juvenile shad. However, despite that conclusion, there is no indication that this technology or other downstream passage studies with juvenile shad were subsequently pursued.

Project Nexus

Juvenile American shad production occurs in the river reach between the Vernon Dam and the Bellows Falls Dam, which is thought to be the historic upstream limit of the shad migration in the Connecticut River. Juvenile American shad require safe and timely downstream passage measures to have the opportunity to contribute to the restoration target population size.

There is little information available regarding the total impact of the Vernon project on downstream migration of juvenile shad. Migration delays, increased predation, mortality during passage over the dam or through turbines, and changes in route selection under different flow conditions are potential influences of the Vernon Dam on the juvenile shad population in the upper Connecticut River. Effective upstream and downstream passage and successful in-river spawning and juvenile production are necessary to help achieve shad management restoration goals for the Connecticut River, particularly in the upstream reaches. Delays in juvenile American shad outmigration may affect survival rates in the transition to the marine environment (Zydlewski et al. 2003).

Proposed Methodology

The impact to juvenile shad outmigrants would be best studied by a combination of approaches including hydroacoustics, radio telemetry (including passive integrated transponder (PIT) telemetry), and turbine balloon tags. Project discharge adjustments at the dam should be examined relative to timing, duration, and magnitude of juvenile shad migration to and through the dam, with hydroacoustic equipment for natural/wild fish information. In addition, study fish should be collected and tagged (PIT, radio, balloon) to then empirically determine rates of survival for fish passed through the project under varied operations, from minimum flows up to full spill conditions. The release of tagged fish (radio, PIT) at a number of potential sites will provide data on delay and route selection as juvenile shad move through the Vernon project area. The number and location of release sites will depend on the availability of tagged fish.

Additional hydroacoustic assessment immediately upstream and downstream of the Vernon Dam will provide information on the timing of migration to and through this area. A more focused survival study, using balloon tags, PIT tags, or other appropriate methods, should be conducted in the second year based upon the first year of study findings relative to the frequency, magnitude, timing, and route selection of juvenile American shad through the Vernon project.

Level of Effort and Cost

TransCanada does not propose any studies to meet this need. Estimated cost for the study is expected to be up to $150,000 with the majority of costs associated with equipment (hydroacoustic gear, radio tags, radio receivers, and PIT readers) and related fieldwork.

Literature cited:

RMC Environmental Services, Inc. 1993. Effect of ensonification on juvenile American shad movement and behavior at Vernon Hydroelectric Station, 1992 – Draft Report, March 1993.

Smith, R. L., and P. C. Downey. 1995. Vermont Yankee/Connecticut River System Analytical Bulletin 69: Relative density and growth of juvenile American shad in the Connecticut River near Vernon, Vermont, 1995.

Zydlewski, J., S. D. McCormick, and J. G. Kunkel. 2003. Late migration and seawater entry is physiological disadvantageous for American shad juveniles. Journal of Fish Biology #63, 1521-1537.

Trout Unlimited respectfully requests the Commission consider these proposed study requests. We also request that the Commission add the following representative to the official service list for this project:

Donald Pugh
10 Old Stage Rd.
Wendell, MA 01379

Sincerely,

Donald Pugh

Study Plan, 18CFR Section 5.9b
Submitted for the Wilder Project, FERC 1892-026

By Linda L. Fowler
Hanover Town Trustee for Pine Park
on behalf of
Trustees of Pine Park Association
linda.fowler@dartmouth.edu

Goals and Objectives:

The goal of the proposed study is to obtain data concerning piping erosion at the shoreline of the Wilder Dam impoundment and to ascertain whether erosion may be reduced by changes in water level management practices by the dam operator. The study will accomplish the following objectives:

1. Identify the effects of the size and rate of river level changes on water transport into soils surrounding the impoundment.
2. Study sites will include known highly erodible soils as well as less easily eroded soils.
3. Study sites will also include locations where bank stabilization using various methods has been performed.
4. Identify sites where piping erosion occurs and estimate the amount of siltation from such sites.
5. Place river level and flow gauges at selected study sites above Wilder Dam.
6. Record and collect measurements of flow and river levels at these gauges and Wilder Dam.
7. Produce a model for the management of water levels and rate of water level change that will reduce erosion.
8. Allow the effectiveness of bank stabilization methods to be tested.

The strategy is to examine the rate and size of water level changes in the reservoir to ascertain whether these variables produce significant changes in the amount or rate of water loading of erodible soils. This information would enable management of river levels that reduce siltation without necessarily compromising the operator's goal to achieve a satisfactory return on its investment.

The study Objective is to gather data on erosive activity and river flows that will assist the operators of the Wilder Dam and FERC in developing a management plan that minimizes erosion. Reducing erosion, in turn, meets several objectives of public importance:

1. improvement of water quality in the reservoir and downstream
2. improvement in the scenic and recreational value of the river
3. preservation of valuable agricultural land – a resource for migrating birds and wildlife
4. reduction in the siltation in the reservoir with resulting loss of storage capacity and dam lifespan
5. increased protection for private and governmental shoreline structures and/or infrastructure
6. **prevent further loss of old trees lining the river bank in Pine Park.**

Relevant Resource Management Goals:

5.9(b)(2) Not relevant

5.9(b)(3) Sections 4(c) and 10(a) of the FPA require the Commission to give equal consideration to all uses of the waterway on which the project is located. When reviewing a proposed action the Commission must consider the environmental, recreational, fish and wildlife, and other non-developmental values of the project as well as power and developmental values.

Public Interest Considerations:
All of the objectives listed in the Study Objective section on page 3, points 1-5, comprise issues that are in the public interest and which the Commission must consider in addition to power generation and development. With respect to Pine Park, the 93-acre, natural reserve in the town of Hanover is a major recreational site with an extensive network of woodland trails that serves the needs of town residents, students at Dartmouth College and the Dresden School District, and members of the surrounding Upper Valley communities.

Existing Information and Need for Additional Information:
The Pine Park Association, a non-profit organization, that owns the 93-acre park in public trust in Hanover, NH, has a Flowage Deed Agreement dating from 1944 with the owner of the Wilder Dam. The deed requires the owner to mitigate damage to the 7500 feet of shoreline of the park along the eastern bank of the Connecticut River north of the Dartmouth rowing facility in Hanover, NH. The last work to mitigage erosion within the park boundaries was completed in 1981. Since then, serious damage has occurred at the northern end of the park, leading to very steep, unstable banks and the loss of a dozen large trees that toppled into the river. Another dozen trees are leaning heavily into the river, which will expose a great deal of loose soil to scouring and piping effects once they fall. Numerous other trees are threatened, posing a future hazard for sections of the hiking trail close to the river.

The Pine Park Trustees do not require a study to compel the TransCanada Corporation to honor its deed. Nevertheless, speakers at the public Scoping Meeting in West Lebanon on January 28th, 2013, presented anecdotal evidence of similar erosion problems with their properties abutting the Wilder mpoundment. They claimed that the rate of erosion had increased in recent memory, changes that corresponded to the transfer of management of the project following assumption of operations by TransCanada. In light of these widespread perceptions, the park trustees think it prudent to obtain a better understanding of why the damage began occuring about a decade ago and why it is accelerating.

Project Nexus:

Connection between the project and its potential effect on the applicable resource.
The application for renewal of the Wilder Dam license intersects with an assortment of resources, including clean water, preservation of riverine habitat, aquatic recreation, and public safety among others.

The applicant recognizes this, and presents in the PAD the results of two studies that address the subject of erosion in the Wilder Dam project area. These two studies have led the applicant to conclude that Project activities have a minimal impact on the above listed resources. (See section 3.4.6 of the PAD and cited above.) It is up to FERC to decide whether the studies the applicant has already performed allow TransCanada to reach the conclusions that are offered in section 3.4.6 of the PAD without further evidence to back those conclusions. *The Existing Information section of proposals submitted by the Towns of Lyme and Lebanon provide abundant evidence that TransCanada cannot conclude that the dam that the dam operation has no significant effect on erosive activity.*

How the information from this study would be used to develop license requirements:

The study will enable TransCanada to fulfill its legal obligation under its 1944 Deed with the Pine Park Association in the most effective manner to insure a long-term resolution of the erosion issues in the park.

Proposed Methodology:

As a small, volunteer citizens' organization, the Trustees of Pine Park are not in a position to propose or comment on study design and methodology.

Level of Effort and Cost:

Again, the Trustees of Pine Park are not able to comment on study costs.

Appendix of supporting documention:

1) Memo from Pine Park Trustees, January 28, 2013, submitted at the public Scoping meeting;
2) Bellows Falls Hydro-Electric and Pine Park Association Flowage Deed Agreement (1944);
3) Copies of orders by FERC for shoreline remediation to the New England Power Company (1978 and 1979);
4) Copy of the Permit for the remediation of the shoreline in Pine Park (1981).

Dartmouth College HANOVER ▫ NEW HAMPSHIRE ▫ 03755-354?

Department of Government, 6108 Silsby Hall
603/ 646-2544 FAX: 603/ 646-2152

January 28, 2013

To: Representatives of Federal Energy Regulatory Commission
From: Pine Park Association Trustees
(Brian Kunz, President; Linda Fowler, Town Trustee)
Re: Erosion of east bank of Connecticut River

The Pine Park Association has a Flowage Deed Agreement dating from 1944 that obliges the owner of the Wilder Dam to mitigate damage to the 7500 feet of shoreline of the park along the eastern bank of the Connecticut River north of the Dartmouth Rowing facility in Hanover, NH. The last work to mitigate erosion along the riverbank was in 1981. In 2010, the Association began a discussion with representatives of TransCanada regarding the severe erosion, the loss of a number of large trees, and the threat to many others at the north end of the park. After a brief flurry of activity, the Association has not received a plan for mitigation or had any communications with representatives of TransCanada.

The Association is a private, non-profit organization responsible for the 93-acre park, which was established in 1900 and expanded through 1912. Since then, the Town of Hanover and Dartmouth College became responsible for the maintenance of the park, but the Association retained the title and all legal powers for its protection and preservation.

TransCanada has a contractual duty to the Association to meet its responsibilities for protection of the bank within the park, as outlined in the deed agreement. In addition, the company is obligated under its 1979 permit renewal to mitigate erosion. The current condition of the shoreline indicates that the TransCanada has been remiss in carrying out both duties. The trustees request, therefore, that renewal of a permit to continue operation of the dam include the requirement that TransCanada fulfill its contractual and license obligations.

We submit the following documents confirming the narrative above:
1. Bellows Falls Hydo-Electric and Pine Park Association Flowage Deed Agreement (1944)

2. Copies of orders by FERC to the New England Power Company (1978 and 1979)

3. Copy of the Permit for remediation of the shoreline in Pine Park (1981)

4. Copies of emails summarizing conversations with Matthew Cole, representative of Trans Canada (May, July 2011).

BELLOWS FALLS HYDRO-ELECTRIC
CORPORATION

AND

PINE PARK ASSOCIATION

FLOWAGE DEED AGREEMENT

FLOWAGE DEED AGREEMENT

In consideration of the delivery of the flowage deed of PINE PARK ASSOCIATION (the Grantor) to BELLOWS FALLS HYDRO-ELECTRIC CORPORATION (the Grantee), dated October 30, 1944, the Grantee - in addition to the payment of ONE THOUSAND - - - - - - - - - - - - - - - - Dollars this day paid, the receipt of which is hereby acknowledged, does hereby agree to fulfill the terms of a certain Indenture by and between said Grantor and said Grantee, dated October 30, 1944.

No agreements or representations not contained in said deed or in the aforesaid agreement shall be binding upon said Grantors and Grantee and the burdens and benefits of the obligations contained in said deed and in the aforesaid agreement shall be binding upon and inure to the benefit of the respective successors and assigns of said Grantors and said Grantee.

Executed in duplicate this 30th day of October, 1944

BELLOWS FALLS HYDRO-ELECTRIC CORPORATION

By Matthew E. Sabourin
~~Agent~~ Vice Pres.

PINE PARK ASSOCIATION

By James P. Richardson
Chairman

By Donald L. Stone
Secretary

THIS INDENTURE made and entered into this 30th day of October, 1944 by and between BELLOWS FALLS HYDRO-ELECTRIC CORPORATION, a corporation duly organized and existing under and by virtue of the laws of the States of Vermont and New Hampshire (hereinafter called "Bellows"), Party of the First Part, and PINE PARK ASSOCIATION, a corporation duly organized and existing under and by virtue of the laws of the State of New Hampshire (hereinafter called "Pine Park"), Party of the Second Part.

WHEREAS Bellows is the owner of certain water rights and privileges on the Connecticut River and now maintains a dam, together with the flashboards thereon, across said River between the Towns of Lebanon, Grafton County, New Hampshire and Hartford, Windsor County, Vermont, known as the "Wilder Dam";

WHEREAS Bellows has plans for the re-development of said water rights and privileges, which include the construction, maintenance and operation of a new dam with flashboards thereon to a higher elevation, together with a power plant connected therewith (hereinafter referred to as the "re-developed project") which will raise the elevation of the waters of said River and its tributaries in the pond formed thereby and cause additional flowage on certain lands and properties along or near said Connecticut River;

WHEREAS Pine Park owns certain lands and properties bordering on or near said Connecticut River in the Town of Hanover, Grafton County, New Hampshire which will be affected by the raising of the elevation of the waters of said Connecticut River and its tributaries as aforesaid;

WHEREAS Pine Park has by deed of even date herewith (to be recorded in Grafton County Registry of Deeds) conveyed certain flowage rights and easements to Bellows, all as set forth in said deed, affecting lands and properties which said Pine Park owns in Hanover, New Hampshire, said lands being more generally shown on a plan entitled: "BELLOWS FALLS HYDRO-ELECTRIC CORP. BELLOWS FALLS, VERMONT PINE PARK ASSOCIATION PROPERTY AT HANOVER, N.H. SCALE 0 400' 800' MARCH 22, 1944 E-6037", a copy of which is hereto attached and made a part hereof and to which reference is hereby made;

WHEREAS, as part of the consideration for said conveyance, Bellows has agreed to perform certain work and to minimize as much as practicable the damage to lands and properties now owned by Pine Park resulting from the raising of the elevation of the waters of said River as aforesaid and the exercise of the right to flow said lands under said deeds;

WHEREAS some of the work to be performed may be done prior to the commencement of operation of the re-developed project and certain of the work to be performed may be done after the commencement of operation of the re-developed project;

NOW, THEREFORE, Bellows hereby covenants and agrees that if it re-develops the water rights and privileges hereinbefore mentioned to any elevation above 370 feet at the dam, it will perform the following work:

1. Prior to the commencement of operation of the re-developed project, Bellows will cut and remove all trees and timber growing on land now owned by Pine Park below an elevation one (1) foot above the elevation of the top of flashboards on the new dam, and such other trees on land of said Pine Park above such elevation as

in the judgment of said Bellows endanger the bank of said River or are apt to die as a result of the raising of the elevation of the pond created by the dam of the re-developed project; provided, however, that Bellows shall not cut such live trees above the aforementioned elevation which Pine Park specifically designates shall not be cut; and after the commencement of operation of any plant as aforesaid, it will from time to time remove such trees as die as a result of the raising of the elevation of said water. All trees and timber cut by Bellows under the provisions hereof shall become the property of Bellows and shall be removed from land of Pine Park.

2. After the start of construction and previous to the raising of the elevation of the pond created by the dam of the re-developed project, and from time to time thereafter, Bellows will use all reasonable efforts and take all reasonable precautions, by installing cribwork, piling, riprap or by other means, to prevent sliding or erosion of those portions of the banks of said River now owned by Pine Park; and in the event any portion of such banks of said River now owned by Pine Park commences to slide or erode, it will take such steps as are reasonably necessary to prevent further sliding or erosion; provided, however, that in the event any sliding or erosion may not have been thus prevented, Bellows will make proper repairs to said banks and will leave the affected area in a clean condition, free from unsightly debris.

3. Prior to the commencement of operation of the re-developed project, Bellows will construct a one-track truck roadway (with suit-

able turnouts) on or over the premises of Pine Park to take the place of that portion of the road now located on said premises along Girl Brook which will be unusable after the raising of the elevation of the waters as hereinbefore set forth; said new road to commence at or about Point "A" and to extend to about Point "B" - all as shown on the plan herein referred to; and to be constructed in such location as is mutually agreed upon by the parties hereto at the time of the construction thereof, and to be at least as good as the present road. Bellows will further do such maintenance as may be necessary, due to defects in construction, for a period of two (2) full years after the completion of the construction of said road.

4. Any and all work performed under any of the terms or provisions hereof will be done in accordance with sound engineering practice and in a good workmanlike manner.

NOW, THEREFORE, Pine Park hereby covenants and agrees:

1. That it will permit the agents, servants and employees of Bellows to enter upon any and all of its lands in order to make surveys and studies of conditions and the ways and means to minimize the damage to said property; and will permit the agents, servants and employees of said Bellows to enter upon its lands with tools, materials and supplies for use in connection with any and all work which Bellows has agreed to perform.

2. That it will allow Bellows, without charge, to construct or

relocate, to the extent required by this agreement, any sewers, trails, roads, drains and pipes upon, over or across any of its lands whenever necessary.

3. That it will use its best efforts to watch the condition of the banks of the Connecticut River and will from time to time, after the commencement of operation of the re-developed project, notify Bellows of any changes in the condition of the banks and the location of any portion of said banks which may be in need of attention.

It is understood and agreed by and between the parties hereto that any work performed by said Bellows in accordance with the terms of this agreement may not be successful in preventing or arresting damage to the lands and property of Pine Park. It is, however, the intention of the parties hereto that Bellows will use all reasonable efforts in accordance with sound engineering practice to minimize the sliding or erosion of those portions of the banks of said River now owned by Pine Park; provided, however, that in the event any sliding or erosion may not have been thus prevented, Bellows will make proper repairs to said banks and will leave the affected area in a clean condition, free from unsightly debris.

The parties hereto agree that this agreement sets forth all that Bellows has agreed to do as consideration for the flowage rights hereinbefore referred to.

All of the provisions herein contained, shall, where the context so admits, be binding upon and enure to the benefit of the parties hereto and their respective successors and assigns.

IN WITNESS WHEREOF, the parties hereto have hereunto interchangeably set their hands and seals as of the day and year first above written.

[illegible]

BELLOWS FALLS HYDRO-ELECTRIC CORPORATION

By [illegible]

Vice Pres.

By ______________________

Witnesses:

Donald L. Stone

Doreen Gale Robinson

PINE PARK ASSOCIATION

By James P. Richardson
Chairman

By Donald L. Stone
Secretary

New England Power Company, Project No. 1892

[61,677]

[¶61,322]

New England Power Company, Project No. 1892

Order Issuing New License

(Issued December 10, 1979)

Before Commissioners: Charles B. Curtis, Chairman; Georgiana Sheldon, Matthew Holden, Jr. and George R. Hall.

New England Power Company (NEPCO) filed an application under Part I of the Federal Power Act for a new major license to authorize the continued operation and maintenance of the constructed Wilder Project No. 1892. The project is located on the Connecticut River, a navigable water of the United States, in Windsor and Orange Counties, Vermont and Grafton County, New Hampshire. [1]

Notice of the filing of an application was issued and the Environmental Defense Fund, Western Massachusetts Public Interest Research Group, Inc., For Lands' Sake, and Trout Unlimited have been permitted to intervene. In addition, numerous late-filed protests related to erosion control have been received and are considered below.

History of the Project

A timber crib dam was built at the Wilder site in 1882 for the purpose of paper manufacture and in 1907 work was commenced on a small powerhouse adjacent to the papermill. In 1924 an additional generator was installed and a small amount of surplus electrical power was sold to a local utility. In 1926, a concrete dam was constructed just downstream of, and to the same elevation as, the timber crib dam. Additional generating units were installed in 1928 and 1937 and the original two units were rehabilitated in 1937-38, thus bringing the total capacity of the five water wheel generating units to 5,220 kW.

On November 6, 1942, Bellows Falls Hydro-Electric Corporation purchased the Wilder Project from Olcott Falls Company and a major license was issued on April 22, 1944. [2] On July 28, 1948, the license was transferred to New England Power Company. Reconstruction of the Wilder Project began in March 1949 and the existing project

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became operational on December 1, 1950. The original license for the project expired on June 30, 1970. The project has been operating under annual licenses since then.

Project Description and Operation

The constructed project includes a concrete gravity-type dam 59 feet high, having a 232-foot long non-overflow section and a 526-foot long spillway section with tainter gates and flashboards. The dam creates a 45-mile long reservoir with a surface area of 3,100 acres at elevation 385 feet msl and with 105 miles of shoreline. At full-pond elevation, the reservoir contains a total volume of about 55,000 acre-feet. The powerhouse contains two 16,200-kW generating units, which, under a maximum gross-head of 53 feet, are capable of producing 33,000 kW at full station load.

The project is operated primarily on a run-of-the-river basis and has 13,500 acre-feet of useable storage. During periods of low flow, off-peak stream flows are stored and the plant is used to supply daily peak load power. During high flow periods, the plant is operated for base load power and passes the water as it is received. The normal pool elevation during the recreation season is 383 feet msl, with a maximum of 385 feet msl and a minimum of 380 feet msl. A more detailed description is given in ordering paragraph (B) below. NEPCO sometimes deviates from the above pattern of operation in order to provide for a minimum flow of 1,200 cfs from the reservoir of its downstream Vernon Project No. 1904, which supplies water to the Vermont Yankee Nuclear Power Plant for cooling purposes. [3] No additional construction or changes in the operation of the project are proposed, except for installation of fish passage facilities, as explained below.

Safety and Adequacy

All project structures, machinery, and appurtenant facilities were inspected by the Commission's staff and found to be adequately maintained and in good operating condition. The Commission's staff has analyzed the project works for stability and found them to be safe against sliding and overturning for various loading conditions, including extreme flooding and earthquake and ice loadings. The analysis demonstrated that the spillway overflow section is stable through the range of water surface elevations. Prior to and including submergence. The spillway has successfully passed all flood flows since 1910, including the maximum flood of record, 91,000 cfs in March 1936. That flood was the greatest in the Connecticut River Basin in 300 years. Both the staff and independent consultants who have analyzed the project works under Part 12 of our Regulations ad consider the spillway capacity adequate. On the basis of our staff's report, we conclude that the project works are safe and adequate.

Comprehensive Development

The drainage area above the the Wilder Dam is approximately 3,375 square miles, or about 30% of the total Connecticut River Basin drainage area. The average flow of the Connecticut River at the project is 5,900 cfs. In addition to the project's 13,500 acre-feet of useable storage capacity, NEPCO owns and operates 232,500 acre-feet of storage capacity upstream from the Wilder Project. NEPCO also utilizes 99,300 acre-feet of storage capacity from the State of New Hampshire's Lake Francis. Operation of the Wilder Project provides 32,400 kW of installed capacity that produces an average annual generation of 136,200 MWh. [4]

The United States Corps of Engineers cited in its report on the application the need for closer coordination of operation of the federal projects and the licensed projects located in the Connecticut River Basin. NEPCO recognizes the need to coordinate the operation of the tributary flood control reservoirs and the main stem power projects during floods. NEPCO has been meeting with personnel of the Corps' Reservoir Control Center to determine how coordination should be carried out. Article 32 of this license requires the licensee to enter into an agreement with the Corps of Engineers for coordination of the project's operation in the interest of flood control and navigation.

The average monthly flow at the project exceeds the hydraulic capacity of the power plant less than 15 percent of the time and, as presently operated, the project utilizes about 82 percent of the available flow. A Commission staff study in 1968 analyzed the feasibility of adding 25,000 kW of new capacity at the project, with an estimated increase in annual generation of 21,000,000 kWh. The analysis at that time developed a cost/benefit ratio of 1.05 which indicated that the installation of additional generating units would be attractive when compared to alternative sources of generation in the area. Changed minimum flow requirements then made the feasibility of additional generation problematic, however. In light of the significantly changed economic conditions since 1973, particularly the escalating costs of non-renewable fuels, the installation of additional generating capacity may now be feasible. Article 37 of this license requires the Licensee to file a feasibility analysis of installing additional generating capacity and, if additional capacity is feasible, a schedule for filing an application to add capacity. Under Article 9 of this license, we retain the authority to require the Licensee to install additional capacity that may be economically feasible.

We conclude that the project as constructed makes effective use of the fall and flow of the Connecticut River and, upon compliance with the terms and conditions of the license, will be best adapted to a plan for comprehensive development of the Connecticut River for beneficial public uses.

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Federal Takeover

Section 14 of the Federal Power Act reserves to the United States the right to take over a non-publicly owned project upon expiration of the license, after paying to the licensee in net investment in the project, not to exceed the fair value of the property taken, plus severance damages, if any. No federal department or agency, state, or municipality recommended takeover or redevelopment of the project by the United States or any other entity. The project is not in conflict with any project authorized or under study by the United States. None of the above governmental units has objected to the relicensing of the project. We know of no reason why federal takeover of the project would better serve the public interest than issuance of this license. Consequently, we shall not recommend Federal takeover.

Fish Passage Facilities

The Department of the Interior (Interior) and the New Hampshire Fish and Game Department (NHFG) recommended that fish passage facilities, needed for the restoration of Atlantic salmon and American shad to upstream reaches of the Connecticut River, should be constructed as soon as possible. The New Hampshire Office of State Planning the New England River Basins Commission and the Vermont Federation of Sportsmen's Club, Inc. expressed similar views. A restoration program was initiated in December 1966. NEPCO has cooperated in studies conducted in conjunction with this program and has contributed funds supporting such studies.

On October 5, 1978, in Docket No. E-7561 , 5 FERC ¶61,033 , the Commission approved a settlement agreement providing a schedule for construction of fish passage facilities at the Wilder Project and at the Vernon Project No. 1904 and the Bellows Falls Project No. 1885, downstream on the Connecticut River. [5] Construction at the Vernon Project is in progress and is expected to be completed during two construction seasons. Preliminary design of fish facilities at the Bellows Falls Project is under way. Preliminary design of fish passage facilities at the Wilder Project will begin by May 1, 1981 and be completed by November 1, 1981. Construction of facilities at Wilder Project is to begin after the later of May 1, 1983 or, depending on the numbers of adult salmon that return to the farther downstream Holyoke Project No. 2004, two years after construction begins at the Bellows Falls Project. Construction must be completed within about two construction seasons. Article 15 of this license provides for continuing supervision of the construction and operation of fish passage facilities at the Wilder Project.

Stream Flow Releases

The Coordinating Committee of the Connecticut River Basin Comprehensive Water and Related Land Resources Study has recommended a minimum flow of 0.2 cfsm (cubic feet per second per square mile of drainage area) for projects on the Connecticut River, to reestablish historic low flow levels. Applied to the drainage area associated with the Wilder Project, that requirement is the equivalent of 675 cfs. The New England River Basin Commission, the Vermont Agency of Environmental Conservation and the Environmental Protection Agency also have recommended a minimum flow release of 0.2 cfsm, with which our staff concurs. [6] On the other hand, the Technical Committee for Fisheries Management of the Connecticut River Basin, the New Hampshire Fish and Game Department, and the Department of the Interior [7] all favored a minimum release of 0.25 cfsm (equivalent to 850 cfs from project No. 1892), to promotoe anadromous fish runs.

In our recent orders issuing licenses for the downstream Vernon Project No. 1904 and the Bellows Falls

Project No. 1855, we require minimum flow releases of 0.2 cfsm. That figure represents the estimated minimum natural flow in the river if the various projects had not been constructed. Accordingly, in Article 33 of this license, we are requiring a minimum flow release of 675 cfs, or 0.20 cfsm, from the project. Should this minimum flow release prove inadequate to protect the Connecticut River fishery, however, we may require higher flow releases under Article 12 or Article 15. As noted above, this license also requires coordination of project operation with the Corps of Engineers for flood control purposes.

Recreation

Adequate public access to project waters is provided by state parks and state boat launch sites, access from highways crossing the project reservoir, privately-owned launch and access areas, and NEPCO-owned and operated facilities. On the New Hampshire side of the reservoir, a visitors' center and picnic area where guided tours of the project dam and powerhouse originate provides an exhibition display area. Sanitary and drinking water facilities provided at the center also serve the users of the nearby picnic area. A portage trail enable canoeists and boaters to get around the dam to a safe distance downstream for continuing their river journey. On the Vermont side of the reservoir, a picnic and boat launching area has been developed upstream of the dam that includes toilets, a launch ramp, a drinking fountain, a parking area and a public ball field. A parking lot on the Vermont shoreline adjacent to the powerhouse is available for use by people who wish to fish in the vicinity of the tailrace. NEPCO proposes to develop a variety of additional facilities to accommodate growing recreational demand, including fishing access, play-ground and picnic facilities, trails and a boat ramp.

The Department of the Interior and our staff both report that NEPCO's Recreation Plan (Exhibit R) adequately provides for public use of the project's recreational resources. NEPCO's biennial filings

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of Form 80 will facilitate continuing review of the adequacy of recreational facilities. If a need for additional facilities develops in the future, the additional development may be required under Article 17 of this license.

Article 33 of this license requires NEPCO to install any safety devices that may be reasonably needed to protect the public using project lands and waters, to the satisfaction on our authorized representative, the Regional Engineer (see Article 4).

Erosion Control

The New Hampshire Fish and Game Department recommended that NEPCO be required to stabilize bank conditions within the impoundment area. The Department contends that fluctuation of the reservoir level has caused serious bank erosion and resultant siltation in the Connecticut River. Intervenors, including For Lands' Sake, have also raised this issue. Over 100 protests [8] to the issuance of a long-term license to NEPCO, prior to completion of the U.S. Army Corps of Engineers study, have been received on the subject of erosion.

We addressed this matter in our earlier "Order Approving Settlement Agreement Concerning Fish Passage Facilities..." [9] There, we recognized that the Corps of Engineers was conducting a study of the Connecticut River to determine the causes of erosion, problem areas and methods to reduce erosion. In our order we denied For Lands' Sake's motion that we not issue a license for the Wilder Project until the erosion study was complete and the findings were reviewed. We found that standard license Article 19 and, if necessary, special articles could retain ample means for us to address any erosion problems the Corps' study might establish.

The Corps' final report on its erosion study is not yet available. [10] Special Article 38 of the license we recently issued for Project No. 1904 already requires NEPCO to file a copy of the Corps' report within 30 days after it is issued. If the Corps' report identifies erosion problems associated with Project No. 1892, we shall then entertain, on our own motion or the motion of others, the question of what mitigative measures might be appropriate.

Historical and Archeological Resources

The State Historic Preservation Officers (SHPO) of Vermont and New Hampshire were requested to review the proposed recreational development for the Wilder Project to determine what effects, if any, relicensing and construction of any new recreational facilities might have on any known archeological remains. The Vermont SHPO stated that the issuance of a license for the Wilder project will not affect properties that are included or eligible for inclusion in the National Register of Historic Places. No response has been received to date from the New Hampshire SHPO, but our staff reports that no site listed in or eligible for the National Register is within the project boundary. Since there are some archeological remains within the project area, however, it is in the public interest to require NEPCO to consult with the SHPOs in both Vermont and New Hampshire before any future construction, to prevent possible loss of any archeological remains within project boundaries. Article 36 of this license will ensure proper protection of historical and archeological resources.

Other Environmental Considerations

Approval of a new license for Project No. 1892 would permit the continued project operation which started in 1910. No additional power facilities are proposed. Continued operation and maintenance of the project and resulting environmental impacts are discussed in this order. The only construction authorized or required by this license is for limited recreational development and will not result in any significant adverse environmental impacts. On the basis of the record, including agency and intervenor comments and the staff's independent analysis, the Commission concludes that issuance of this new license for Project No. 1892, as conditioned, is not a major federal action significantly affecting the quality of the human environment.

License Term

Our usual policy on relicensing is to limit the license term to 30 years if no substantial development is contemplated or proposed. [11] On December 8, 1978, the City of Lebanon, N.H. filed a letter stating the interest of its citizens in filing a competing application for long-term license; and at elections in both Lebanon and Hartford, Vt., qnestions were later presented on the question of whether to apply for the license for the project. In each instance, the polls failed to support filing of either a petition to intervene on NEPCO's application or a competing application. The Lebanon City Council did, however, recommend that we issue a 25-year license to NEPCO. "Listen," a citizens group based in Lebanon that is not an intervenor, submitted comments urging year-to-year licensing rather than a 50- or 25-year license, to allow the City of Lebanon to intervene in the "near future," should municipal power become economically attractive and feasible.

The City of Lebanon and its inhabitants have had more than ample opportunity to file a competing application for the Wilder Project and have chosen not to. We believe it would be inconsistent with Section 15 of the Federal Power Act and sound administrative practice to continue issuing only annual licenses to NEPCO just to allow others an indefinitely long opportunity to compete for a long-term license. In the circumstances of this project we consider a long-term license of about 38 years to be warranted, even though NEPCO does not propose to add new generating capacity. The Wilder Project is located upstream from the Turners Falls Project No. 1889, the Northfield Mountain Project No. 2485, the Vernon Project No.

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1904, and the Bellows Falls Project No. 1855. The expiration date of the licenses for the Northfield Mountain Project, which makes joint use of the Turners Falls Reservoir, and the Vernon and Bellows Falls Projects is April 30, 2018. In the interests of coordinating the administration of projects on this reach of the Connecticut River, the license for Project No. 1892 will terminate on April 30, 2018, too. [12]

Exhibit K

NEPCO's Exhibit K shows a project boundary which, in general, follows the outer lot lines of lands owned in fee and which follows contour lines, as designated on each drawing, on lands over which NEPCO holds only flowage rights. NEPCO states that the exact location of the line delineating the outside limits of its flowage rights cannot be determined since its location changes under varying flood, ice, and other conditions. It also states that it includes in the project all of the rights which it has to flow water over the lands and properties of others. The entire parcels over which NEPCO has flowage rights, however, are not shown as included within the project boundary on the Exhibit K maps.

Our staff recommends that NEPCO be required to file a revised Exhibit K to define clearly the limits of the lands over which NEPCO holds only flowage rights for the project. Article 38 requires NEPCO to file such a revised Exhibit K for approval. The project boundary should be revised to encompass highwater levels, *i.e.,* all lands on which waters flow when the reservoir is at full pond (including increase in the water level in upstream reaches because of backwater effects), and all other land which is necessary for project purposes. Where a flowage casement applies to an entire tract of land and is not otherwise defined, the project boundary may enclose the entire tract.

The Commission orders:

(A) This license is issued to New England Power Company Licensee) of Westboro, Massachusetts, under Part I of the Federal Power Act (Act), for a period effective the first day of the month in which the continued operation and maintenance of the Wilder Project No. 1892, located in Orange and Windsor Counties. Vermont, and Grafton County, New Hampshire, on the Connecticut River, a navigable waterway of the United States. This license is subject to the terms and conditions of the Act, which is incorporated by reference as part of this license, and subject to the Regulations the Commission issues under the provisions of the Act.

(B) The Wilder Project No. 1892 consists of:

(1) All lands, to the extent of the Licensee's interests in those lands, constituting the project area and enclosed by the project boundary, the project area and boundary being shown and described by certain exhibits which form part of the application for license and which are designated and described as:

Exhibit	FERC No. 1892	Showing
J-Sheet 2A	76	General Map
K-2	77	Project Map
K-3	78	Project Map
K-3; 1A-18	79	Project Map
K-3; 2A-18	80	Project Map
K-3; 3A-18	81	Project Map
K-3; 4A-18	82	Project Map
K-3; 5A-18	83	Project Map
K-3; 6A-18	84	Project Map
K-3; 7A-18	85	Project Map
K-3; 8A-18	86	Project Map
K-3; 9A-18	87	Project Map

K-3; 10A-18	88	Project Map
K-3; 11A-18	89	Project Map
K-3; 12A-18	90	Project Map
K-3; 13A-18	91	Project Map
K-3; 14A-18	92	Project Map
K-3; 15A-18	93	Project Map
K-3; 16A-18	94	Project Map
K-3; 17A-18	95	Project Map
K-3; 18 -18	96	Project Map

(2) Project works consisting of: (1) a concrete gravity-type dam 59 feet high, comprising a 232-foot long non-overflow section and a 526-foot long spillway section with taintor gates and flashboards; (b) a 45-mile long reservoir having a surface area of 3,100 ares at elevation 385 feet m.s.l., with 105 miles of shoreline and a total volume of about 55,000 acre-feet at full-pond elevations; (c) a powerhouse containing two 16,200-kW generating units; (d) transmission facilities consisting of: (i) two generator leads to the 13.8-kV bus; (ii) the 13.8-kV bus; (iii) the two banks of 13.8/46-kV step-up transformers; (iv) the 13.8/115-kV step-up transformer bank; and (v) the 115-kV appurtenances to connect to the 115-kV bus at which the Vermont Electric Power Company, Inc., and the 115-kV Wilder-Bellows Falls lines are connected; and (e) appurtenant facilities.

The location, nature and character of these project works are generally shown and described by the exhibits cited and more specifically shown and described by certain other exhibits which also form a part of the application for license and which are designated and described as:

Exhibit	FERC No. 1892-	Showing
L - 1d	97	General Layout
L - 2d	98	Dam and Powerhouse (general plan)
L - 3d	99	Dam - Typical Sections
L - 4d	100	Dike and Yard
L - 5d	101	Profile and Down-
L - 6c	102	Powerhouse and

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L - 7c	103	Powerhouse Basement
L - 8c	104	Powerhouse Section
L - 9c	105	Future Unit Bay

Exhibit M: consisting of three pages showing "General Description and General Specifications of Mechanical, Electrical and Transmission Equipment" filed June 23, 1969.

Exhibit R: consisting of: (1) 14 pages of text; (2) Appendix entitled "Estimated Public Visitation 1959-1968; Ultimate;" and (3) Exhibit R drawing No. 1892-106, entitled "General Recreation Map," and No. 1892-107, entitled "General Recreation Map - Plant Area," as filed June 23, 1969, and supplemented on September 2, 1971.

Exhibit S: filed on September 2, 1971 consisting of text entitled "Fish and Wildlife Report."

(3) All of the structures, fixtures, equipment or facilities used or useful in the maintenance and operation of the project and located on the project area, all protable property which may be employed in connection with the project, located on or off the project area, as provided by the Commission, and all riparian or other rights which are necessary or appropriate in the maintenance or operation of the project.

(C) Exhibits J, L, M and R, designated and described in ordering paragraph (B) above, are approved and made a part of this license. Exhibit K, designated and described in ordering paragraph (B), is approved and made a part of this license only to the extent that is shows the general location, nature, and description of the project and subject to Article 38 of this license. Exhibit S, designated and described in ordering paragraph (B), is approved and made part of the license subject to the Commission's "Order Approving Settlement Agreement Concerning Fish Passage Facilities...," Docket No. E-7561 , Project Nos. 1904, 1855 and 1892 (issued October 5, 1978).

(D) This license is also subject to Articles 1 through 28 set forth in Form L-3 (Revised October 1975, Sec. 54 FPC 1817) entitled "Terms and Conditions of License for Constructed Major Project Affecting Navigable Waters of the United States," attached to and made a part of this license. This license is also subject to the following special conditions set forth as additional articles:

Article 29. Pursuant to Section 10(d) of the Act, a specified reasonable rate of return upon the net investment in the project shall be used for determining surplus earnings of the project for the establishment and maintenance of amortization reserves. One-half of the project surplus earnings, if any, accumulated under the license, in excess of the specified rate of return per annum on the net investment, shall be set aside in a project amortization reserve account at the end of each fiscal year: Provided, that, if and to the extent that there is a deficiency of project earnings below the specified rate of return per annum for any fiscal year under the license, the amount of such deficiency shall be deducted for the amount of any surplus earnings accumulated thereafter until absorbed, and one-half of the remaining surplus earnings, if any, cumulatively computed, shall be set aside in the project amortization reserve account; and the amounts thus established in the project amortization reserve account shall be maintained therein until further order of the Commission.

The annual specified reasonable rate of return shall be the sum of the weighted cost components of long-term debt, preferred stock, and the cost of common equity, as defined herein. The weighted cost component for each element of the reasonable rate of return is the product of its capital ratios and cost rate. The current capital ratios for each of the above elements of the rate of return shall be calculated annually based on an average of 13 monthly balances of amounts properly includable in the Licensee's long-term debt and proprietary capital accounts as listed in the Commission's Uniform System of Accounts. The cost rate for such ratios shall be the weighted average cost of long-term debt and preferred stock for the year and the cost of common equity shall be the interest rate on 10-year constant maturity series) computed on the monthly average for the year in question plus four percentage points (400 basis points).

Article 30. For the purpose of reimbursing the United States for the cost of administration of Part I of the Act, the Licensee shall pay the United States, a reasonable annual charge as determined by the Commission in accordance with the provisions of its Regulations in effect from time to time. The authorized installed capacity for that purpose is 45,800 horsepower.

Article 31. Licensee shall implement, and modify when appropriate, the emergency action plan on file with the Commission designed to provide an early warning to upstream and downstream inhabitants and property owners if there should be an impending or actual sudden release of water caused by an accident to, or failure of, project works. That plan shall include: instructions to be provided on a continuing basis to operators and attendants for actions they are to take in the event of an emergency; detailed and documented plans for notifying law enforcement agents, appropriate Federal, State, and local agencies, operators of water-related facilities, and those residents and owners of properties that could be endangered; actions that would be taken to reduce the inflow to the reservoir, if possible, by limiting the outflow from upstream dams or control structures; and actions to reduce downstream flow by controlling the outflow from

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dams located on tributaries to the stream on which the project is located. Licensee shall also maintain on file with the Commission a summary of the study used as a basis for determining the areas that may be affected by an emergency, including criteria and assumptions used. Licensee shall monitor any changes in upstream or downstream conditions which may influence possible flows or affect areas susceptible to damage and shall promptly make and file with the Commission appropriate changes in the emergency action plan. The Commission reserves the right to require modifications to the plan.

Article 32. The Licensee shall enter into an agreement with the Department of Army, Corps of Engineers (Corps), providing for the coordinated operation of the project, in the interest of flood control and navigation, on the Connecticut River in accordance with rules and regulations prescribed by the Secretary of the Army. A conformed copy of the agreement shall be filed with the Commission within one year of the date of issuance of this license. If the Licensee and the Corps fail to reach agreement, then within one year from the date of issuance of this license the Licensee shall file its proposals for coordinated operation of the project with other water resource projects on the Connecticut River, together with a copy of the Corps' objections to the Licensee's proposals. The Commission reserves the right to impose conditions on the Licensee for coordinated operation of the project.

Article 33. The Licensee shall, to the satisfaction of the Commission's authorized representative, install and operate any signs, lights, sirens, barriers, or other devices that may be reasonably needed to warn the public of fluctuations in flow from the project and to protect the public in its recreational use of project lands and waters.

Article 34. In the interests of protecting and enhancing the scenic, recreational, and other environmental values of the project, Licensee: (1) shall supervise and control the use and occupancy of project lands and waters; (2) shall prohibit, without further Commission approval, the further use and occupancy of project lands and waters other than as specifically authorized by this license; (3) may authorize, without further Commission approval, the use and occupancy of project lands and waters for landscape plantings and the construction, operation and maintenance of access roads, power and telephone distribution lines, piers, landings, boat docks, or similar structures and facilities, and embankments, bulkheads, retaining walls, or other similar structures for erosion control to protect the existing shoreline; (4) shall require, where feasible and desirable, the multiple use and occupancy of facilities for access to project lands and waters; and (5) shall ensure to the satisfaction of the Commission's authorized representative that all authorized uses and occupancies of project lands and waters: (a) are consistent with shoreline aesthetic values, (b) are maintained in a good state of repair, and (c) comply with State and local health and safety regulations. Under item (3) of this article, Licensee may, among other things, institute a program, for issuing permits to reasonable extent for the authorized types of use and occupancy of project lands and waters. Under appropriate circumstances, permits may be subject to the payment of a fee in a reasonable amount. Before authorizing the construction of bulkheads or retaining walls, Licensee shall: (a) inspect the site of the proposed construction, (b) determine that the proposed construction is needed, and (c) consider whether the planting of vegetation or the use of riprap would be adequate to control erosion at the site. If an authorized use or occupancy fails to comply with the conditions of this article or with any reasonable conditions imposed by the Licensee for the protection of the environmental quality of project lands and waters, the Licensee shall take appropriate action to correct the violations, including, if necessary, cancellation of the authorization and removal of any non-complying structures or facilities. The Licensee's consent to an authorized use or occupancy of project lands and waters shall not, without its express agreement, place upon the Licensee any obligation to construct or maintain any associated facilities. Licensee shall, within 60 days prior to commencement of a program for issuing permits, furnish a copy of its guidelines and procedures for implementing the program to the Commission's authorized representative and its Director, Office of Electric Power Regulation. Whenever the Licensee makes any modification to these guidelines and procedures, it shall promptly furnish a copy to each of those persons. The Commission reserves the right to require modifications to these guidelines and procedures.

Article 35. The Licensee shall maintain a continuous minimum flow of 675 cfs (0.20 cubic feet per second per square mile of drainage basin) or a flow equal to the inflow of the reservoir, whichever is less, from the project into the Connecticut River. These flows may be modified temporarily: (1) during and to the extent required by operating emergencies beyond the control of the Licensee; and (2) in the interest of recreation and protection of the fisheries resources upon mutual agreement between the Licensee and the Fish and Game Departments of the States of New Hampshire and Vermont.

Article 36. Prior to the commencement of any construction or development of any project works or other facilities at the project, the Licensee shall consult and cooperate with the appropriate State Historic Preservation Officer(s) (SHPO) to determine the need for, and extent of, any archeological or historic resource surveys and any mitigative measures that may be necessary. The Licensee shall provide funds in a reasonable amount for such activity. If any previously unrecorded archeological or historic sites are discovered during the course of

[61,684]

construction, construction activity in the vicinity shall be halted, a qualified archeologist shall be consulted to determine the significance of the sites, and the Licensee shall consult with the SHPO to develop a mitigation plan for the protection of significant archeological or historic resources. If the Licensee and the SHPO cannot agree on the amount of money to be expended on archeological or historic work related to the project, the Commission reserves the right to require the Licensee to conduct, at its own expense, any such work found necessary.

Article 37. The Licensee shall, within six months from the date of issuance of the license, prepare and file with the Commission a feasibility analysis of installing additional generating capacity at the Wilder Project, taking into account, to the extent reasonable, all benefits that would be derived from the installation, including any contribution to the conservation of non-renewable natural resources. If the study shows additional capacity to be economically feasible, the Licensee shall simultaneously file a schedule for filing an application to amend its license to install that capacity.

Article 38. Within one year from the date of issuance of this license, the Licensee shall file for approval a revised Exhibit K conforming to the requirements of §4.41 of the Commission's Regulations and the order issuing this license and clearly delineating the limits of the lands over which it holds flowage rights for the project.

(E) This order is final unless an application for rehearing is filed within 30 days from the date of its issuance, as provided in Section 313(a) of the Act. The filing of an application for rehearing does not operate as a stay of the effective date of this license or of any other date specified in this order, except as specifically ordered by the Commission. Failure of the Licensee to file an application for rehearing shall constitute acceptance of this license. In acknowledgment of acceptance of this license, the license shall be signed for the Licensee and returned to the Commission within 60 days from the date of issuance of this order.

-- **Footnotes** --

[1] The application was filed on June 23, 1969, and supplemented at various times, the latest being the filing of September 2, 1971.

[2] A condition of the license required the redevelopment of the project. 4 FPC 3, 5 (1944).

[3] The license for the Vernon Project was amended for the use of the project as a source of cooling water by order dated July 31, 1970, 44 FPC 220. Pursuant to that order, NEPCO maintains a minimum stream flow through the Vernon Project of 1,200 cfs to prevent excessive heat buildup in the reservoir. Under the new license recently issued for the Vernon Project, NEPCO must maintain a minimum flow release of 1250 cfs New England Power Company, Project No. 1904, Order Issuing New License (issued June 25, 1979) (7 FERC ¶61,292 , mimeo at 15).

[4] The project uses a renewable energy resource that saves the equivalent of about 223,000 barrels of oil or 63,000 tons of coal annually.

[5] Signatories to the settlement agreement included the intervenors in this proceeding and the states of Connecticut, Massachusetts, New Hampshire and Vermont.

[6] The New Hampshire Water Supply and Pollution Control Commission certified the project's compliance with New Hampshire water quality standards. The Vermont Agency of Environmental Conservation waived state certification under §401 of the Federal Water Pollution Control Act on condition that the 0.20 cfsm flow release be maintained.

[7] Interior's actual recommendation is somewhat unclear because at one point in its comments it recommended a 675 cfs minimum flow release.

[8] Including the Hanover Conservation Commission; the Town of Norwich, Vermont; Congressmen James M. Jeffords of Vermont and James Cleveland of New Hampshire; the Connecticut River Watershed Council; and individual citizens.

[9] *New England Power Co.,* Docket No. E-7561 , Project Nos. 1904, 1855 and 1892 (issued October 5, 1978, 5 FERC ¶61,019).

[10] The President of For Lands' Sake has recently submitted a letter asking that note be taken of certain enclosures alleged to be part of the Corps' consultants' "final" draft of the report on the erosion study. The letter and enclosures were not properly submitted in accordance with our rules, with proof of service on other parties, and thus have not been considered. In any event, the consultants' draft may not be final and the Corps' final report may very from that draft. To the extent that matters in the consultants' draft are reflected in the Corps' final report, we shall, of course, consider them then available.

[11] *See The Montana Power Co.,* Mystic Lake Project No. 2301, Order Issuing New License (Major) (issued October 5, 1976, 56 FPC 2008).

[12] Moreover, assuming the requisite number of adult salmon return to the Holyoke Project, NEPCO will be investing a significant amount of new capital in the Wilder Project to provide fish passage facilities.

COMM-OPINION-ORDER, 5 FERC ¶61,019, **New England Power Company, Docket No. E-7561, Project Nos. 1904, 1855, and 1982**, (Oct. 05, 1978)

New England Power Company, Docket No. E-7561, Project Nos. 1904, 1855, and 1982

[61,032]

[¶61,019]

New England Power Company, Docket No. E-7561, Project Nos. 1904, 1855, and 1982

Order Approving Settlement Agreement Concerning Fish Passage Facilities At Project Nos. 1904, 1855, and 1982 and Approving Preliminary Plans for Fish Passage Facilities at Project No. 1904

(Issued October 5, 1978)

Before Commissioners: Charles B. Curtis, Chairman; Don S. Smith, Georgiana Sheldon, Matthew Holden, Jr. and George R. Hall.

On December 30, 1977, the Commonwealth of Massachusetts filed for Commission [1] approval a proposed settlement agreement concerning fish passage facilities at three hydroelectric projects on the Connecticut River licensed to the New England Power Company (NEPCO). Proceeding upstream in order, these projects are the Vernon Project, No. 1904, the Bellows Falls Project, No. 1855, and the Wilder Project, No. 1892. The signatories to the settlement agreement are NEPCO, the States of Massachusetts, Connecticut, New Hampshire, and Vermont, the U.S. Fish and Wildlife Service (USFWS), the Environmental Defense Fund, the Massachusetts Public Interest Research Group, Inc., For Land's Sake (FLS), and Trout Unlimited. [2]

On January 30, 1978, NEPC filed for Commission approval four sheets of Exhibit S drawings depicting functional plans for construction of fish passage facilities at the Vernon Project. These drawings were filed pursuant to the fish facility settlement agreement referred to above.

BACKGROUND

American shad and Atlantic salmon are anadromous fish native to the Connecticut River. The construction of dams for five licensed projects on the river [3] created barriers to the natural upstream migration of these anadromous fish. Docket No. E-7561 is the result of a 1971 Commission order [4] establishing an investigation into the possibility of restoring annual runds of shad and salmon to the Connecticut River and any appropriate measures to be taken at the five licensed projects to aid the restoration effort. The Commission has already provided for modification or construction of fish passage facilities at the Holyoke and Turners Falls Projects, pursuant to earlier settlement agreements. [5]

THE SETTLEMENT AGREEMENT

The settlement agreement before us now sets forth a schedule for the design, construction, and operation of fish passage facilities by NEPCO at Vernon, Bellows Falls, and Wilder. Public notice of

[61,033]

the settlement agreement was given on February 3, 1978, with March 13, 1978 as the last day for filing protests or petitions to intervene. None was received. Commission staff filed comments on March 13, 1978 seeking to clarify some of the provisions of the settlement agreement. The signatories to the settlement field a response to staff's comments on July 14, 1978.

1. *Design.*

Section I of the settlement agreement provides the timetable for decision on the facilities at each project.[6] Final design of the Vernon facilities will begin within 30 days of either approval of the preliminary design by the fisheries agencies and the Commission[7] or completion of model studies -- whichever comes later -- and be completed within a year. For facilities at Bellows Falls, preliminary design of fish passage facilities will begin before the year ends and will be filed within six months after commencement. Final design will begin 30 days after either approval of the preliminary design by the fisheries agencies and the Commission or the return of 30 adult salmon to the Holyoke Project in a single year -- whichever comes later -- and be completed within nine months. At Wilder, preliminary design will begin by May 1, 1981 and will be completed within six months. The final design steps will be similar to and will follow by two years those for Bellows Falls.

2. *Construction.*

Section II of the agreement contains the schedule for construction of the facilities. The dates are subject generally to timely approval of the final design at each project by the fisheries agencies and the Commission. Section IV provides that any time limits in the settlement agreement may be modified at any time by up to twelve months upon mutual written agreement of the signatories.

The construction schedule in Section II calls for the Vernon facilities to be ready to operate by May 1, 1981. The facilities at Bellows Falls are to be ready to operate within approximately two years after either issuance and acceptance of a new long-term license for the project, or the return of 30 adult salmon to the Holyoke Project in a single year, or May 1, 1981 -- whichever is latest. The Wilder facilities are to be ready to operate within approximately two years after either issuance and acceptance of a new long-term license for that project, or May 1, 1983, or if certain minimum numbers of salmon continue to return to Holyoke, two years after construction is commenced at Bellows Falls -- whichever is latest.

The principal question raised in staff's comments related to the number (thirty) of Atlantic salmon returning to Holyoke that triggers final design and construction of the Bellows Falls fishway. Staff considered this triggering figure in conjuction with the provision that the states may release as few as 10 percent of those salmon to continue migrating upstream after the Bellows Falls fishway is operating.[8] Staff noted that under these provisions very few fish (as low as three) might be released for upstream migration and spawning. Staff contended that, if only a few salmon were released, it would be unreasonable to expect a significant number to find their way successfully to tributary spawning areas, resulting in the waste of the released fish. In such circumstances, it might be better either to use the 10 percent to augment the 90 percent being collected to establish a brood stock or to increase the triggering number.

In response, the signatories indicated that returning adult Atlantic salmon will be collected for brood stock at fishways on downstream tributaries -- Farmington River and Salmon River -- as will as at Holyoke. Therefore, it is expected that at least 60 fish would be collected for brood stock before construction of upstream fishways would begin. The signatories also stated that the 10 percent release figure is only a minimum, and was included in the agreement of assure NEPCO that when the fishway is completed at Bellows Falls, salmon will be released for passage through it. The signatories further advised that they would not release only a few fish if it appeared that those fish would be wasted. Their response indicates that the actual number of fish released will depend upon the fishery management decisions made by the fisheries agencies. Staff has concurred with the statement of clarification and has encouraged all decisions on the distribution of returning adult fish to be made by the fisheries agencies.

3. *Other Fish Facility Provisions.*

Section III requires NEPCO to report every other month to the Commission on the status of the work on fish passage facilities at the three projects. Section V permits NEPCO to seek outside sources of funding for the facilities, but provides that failure or delay in securing such funding would not relieve NEPCO of its obligations under the settlement agreement.

Sections VI and VII provide guidelines for the operation of fish passage facilities at the three projects and for the maintenance of minimum flows. IF NEPCO and the States failed to agree on the actual operating regime of the facilities, it would be determined by a panel of three fish biologists (NEPCO, the States, and the Commission would each appoint one). In Section IX, the fisheries agencies and intervenors agree to certain limitations on the construction of further fish passage facilities at the three projects.

4. *Erosion.*

Finally, Section X of the settlement provides that inclusion of standard Article 19 of the Commission's Form L-3 (See 54 FPC 1817) in any new long-term licenses for the three projects would satisfy all issues regarding possible erosion raised by the intervenors in 1973. We note, however, that

[61,034]

FLS has taken action that might be interpreted to contradict this provision of the Settlement Agreement partially. On September 5, 1978, FLS filed a motion [9] which asks that we not issue a new long-term license for the Wilder Project until a current Army Corps of Engineers' study of erosion along the Connecticut River is completed and the findings have been reviewed. [10] FLS also moves that we "require implementation of any relevant recommendations regarding the method of operation of the dam that may be made in the Corps study, specifying same in the license." As the sole ground for its motion, FLS states that a license granted before the results of the Corps' study are available:

> * * * could only contain the standard erosion clause [Article 19 of Form L-3 (Rev. October, 1975)], which is applicable to all hydroelectric facilities and therefore is abstract and general, whereas if the Commission waits * * * until the recommendations of the completed Corps' study are available, it would spell out specifically in the language of the license the methods of operation that will cause the least erosion in the Wilder Pool.

To eliminate any possible undertainty about the effect of FLS's motion on the settlement agreement, we believe it proper and desirable to rule on the motion now. We shall deny the motion.

In the first place, standard Article 19 of Form L-3 in itself would retain ample means for us to address any erosion problems the Corps' study might establish. That Article provides:

> Article 19. In the construction, maintenance, or operation of the project, the Licensee shall be responsible for, and shall take reasonable measures to prevent, soil erosion on lands adjacent to streams or other waters, stream sedimentation, and any form of water or air pollution. The Commission, upon request or upon its own motion, may order the Licensee to take such measures as the Commission finds to be necessary for these purposes, after notice and opportunity for hearing.

This article's very generality, which FLS seems to find troublesome, is advantageous. Under its provisions we would be able to order NEPCO to take whatever erosion control measures we found necessary upon review of the Corps' study. [11] The Commission could still "spell out specifically" then any changes in "the methods of operation" of the Wilder Project required to control erosion.

In any event, contrary to FLS's belief, in licensing the Wilder Project we would not be limited to inclusion of only standard Article 19. If we should determine on the record before us at the time of any licensing decision that more specific conditions related to the Corps of Engineers' erosion study are suitable for protection of the public interest, we could include an appropriate special article in the license. And nothing in Section X of the settlement agreement purports to restrict our authority to issue special conditions related to erosion. We do not, however, suggest here that we will or will not include any such special article in a new license for the Wilder Project; deciding that now would simply be premature.

Nor should our action in denying FLS' motion be interpreted as suggesting either that we will or will not issue a new license to NEPCO; or that we will or will not issue such a license before the Corps' erosion report is available. [12] We will decide these matters in the relicensing proceeding, when the time is ripe. Here we decide only that FLS has not shown any good reason for us to postpone licensing of the Wilder Project until after the Corps' erosion report is available. We are well aware of the Corps' erosion report is available. We are well aware of the Corps' study and have no intention of ignoring its results. We will retain adequate regulatory control to require any measures we find proper to mitigate demonstrated project-induced erosion even if we should license the project before the Corps has reported.

5. *Approval of Settlement Agreement.*

The settlement agreement is the result of extended negotiations by the signatories to establish a schedule of fish facility construction at these three projects. The agreement provides for an acceptable general method of constructing the proposed fish facilities in stages, as anadromous fish extend their migratory range upstream. Based on our review of the agreement and Staff's comments and the response from the signatories, we believe that the agreement adequately provides for upstream fish passage facilities at Vernon, Bellows Falls, and Wilder, and that the agreement is thus in the public interest and should be approved.

FACILITIES AT THE VERNON PROJECT

Pursuant to the settlement agreement above, NEPCO filed for Commission approval Exhibit S Drawings showing the preliminary design of fish passage facilities at the Vernon Project. Copies of the Exhibit S drawings were sent for comment to appropriate state and Federal agencies on May 11, 1978. The agencies responding [13] all commented favorably on the proposed preliminary design.

The proposed fishway at the Vernon Dam was developed cooperatively by NEPCO and the interagency Technical Committee for Fisheries Management of the Connecticut River Basin, with active participation by a Commission staff fishery biologist. The fishway is an "Ice Harbor" type, with a vertical slot-type ladder leading from the gatehouse to the reservoir. This same type of design was used for the Turners Falls fishway, and it has a long record of success in passing salmon and shed at hydroelectric dams in the Pacific Northwest. Commission staff considers this type of ladder to be the most efficient design in passing anadromous fish at large dams and the most economical type of large fish ladder to construct and to operate. The design

[61,035]

appears to use the existing project structures, insofar as possible, and takes into account the hydraulics of the project's operation to attract migratory fish for collection.

The Exhibit S functional drawings include the general plan for the fish passage facilities, various sections of the fish ladder from the entrance at the downstream face of the powerhouse to the exit into the reservoir, cross sections of a typical weir, and flow diagrams at four different tailwater elevations. Hydraulic model studies of the entrance and exit sections of the fishway are still in progress, but Commission staff states that this work will not result in a significant change in the configuration of the ladder as shown in the preliminary design.

The fish passage facility proposed at the Vernon Project is designed to pass an annual migration of 750,000 American shad and 40,000 Atlantic salmon. (A fish counting station to enumerate migrating fish would be located about midway up the ladder.) NEPCO has indicated that, upon receipt of Commission approval, it is prepared to begin final design of the fish facilities as shown on the functional Exhibit S drawings. Construction is scheduled to start by May 1, 1979. A detailed cost estimate of the facilities has not been completed, but Commission staff reports that preliminary estimates of capital costs discussed during technical meetings have ranged from five to seven million dollars.

The environmental effects of constructing the proposed facilities would be minimal. The work on land would be concentrated in small areas already cleared of vegetation. Construction activities within the meander of the river would be enclosed within cofferdams. The collection galleries would be concrete and would rest on concrete supports anchored to rock foundations. The work would occur during two construction seasons. There would be some construction noise during this period, and possibly some minor turbidity when the cofferdams are installed and removed. These temporary effects would be minor and would cease upon completion of construction. The state and Federal agencies commenting favorably on the Exhibit S drawings are thoroughly familiar with the anadromous fish restoration program and with any environmental consequences of its implementation, but have identified no significant adverse effects from installation of the proposed facilities. For these reasons and considering our staff's independent analysis, we conclude that approval of the functional Exhibit S drawings and the subsequent construction of the fish facilities as depicted by the drawings is not a major Federal action significantly affecting the quality of the human environment.

The proposed Exhibit S drawings conform substantially to the requirements of our Regulations. We find it appropriate and in the public interest to approve the Exhibit S drawings for fish passage facilities at the Vernon Project submitted by NEPCO.

The Commission orders:

(A) The Settlement Agreement filed December 30, 1977, concerning fish passage facilities on the Connecticut River at Project Nos. 1904, 1855, and 1892, is approved and incorporated by reference in this order. New England Power Company shall comply with the provisions of the settlement agreement.

(B) Nothing in this order shall prejudice any past or future Commission findings or orders or any claims or contentions that may be made by the Commission, its staff, or any party or persons affected by this order, in any other proceeding uow pending or that may be instituted.

(C) The following Exhibit S drawings showing the preliminary design for fish passage facilities at Project No. 1904, filed January 30, 1978, consisting of four sheets, are approved and made a part of the license for Project No. 1904:

Exhibit S	FERC No.	Showing
Sheet 1	1904-67	General Plan
Sheet 2	1904-68	Fishway Sections
Sheet 3	1904-69	Fishway Sections
Sheet 4	1904-70	Flow Diagrams

-- **Footnotes** --

[1] This proceeding was commenced before the FPC. By the joint regulation of October 1, 1977 (10 CFR 1000.1), it was transferred to the FERC. The term "Commission," when used in the context of action taken prior to October 1, 1977, refers to the FPC; otherwise, it refers to the FERC.

[2] The term "fisheries agencies" in this order will be used to refer collectively to the four states and

USFWS.

[3] The three projects named above plus two others further downstream, the Holyoke (or Hadley Falls) Project No. 2004 and the Turners Falls Project No. 1889.

[4] *Holyoke Water Power Co., New England Power Co., Western Massachusetts Electric Co.,* Docket No. E-7561 , Order Instituting Investigations, Consolidating Proceedings, and Directing that a Hearing be Held, 45 FPC 939 (1971).

[5] *Holyoke Water Power Co., et al.,* Docket No. E-7561 , Order Prescribing Modifications to Fish Facilities and Continuing Proceeding, 49 FPC 1067 (1973); *Holyoke Water Power Co., et al.,* Docket No. E-7561 . Order Approving Settlement Agreement with Modification (November 8, 1976, 56 FPC 2914).

[6] In its comments of March 13, 1978, staff stated its interpretation of these provisions. The signatories concurred in staff's construction in their response of July 14, 1978. We will follow the parties' agreed interpretation.

[7] As noted above, NEPCO filed the preliminary design at the Vernon facilities for Commission approval on January 30, 1978.

[8] Section VI (C). The agreement contemplates that before releasing any Atlantic salmon above Holyoke, the fisheries agencies will collect the first returning adults in trapping facilities and take them to a hatchery to establish a brood stock.

[9] The motion is captioned with reference to both this proceeding and the proceeding on relicensing of the Wilder Project No. 1892.

[10] FLS states that: This study is scheduled for completion

[61,036]

early in 1979, to be followed by a Final Report outlying conclusions about the causes of erosion behind the [Wilder, Bellows Falls, Vernon, and Turners Falls] dams and containing recommendations for any changes in the operations of the dams that may minimize erosion on the banks of the river.

[11] Assessment of the Corps' study and recommendations, as well as other relevant matters of record, would clearly be prerequisite to our imposing any particular erosion control measures recommended. Thus, we deny FLS's request that we categorically include in the license for Wilder *any* measures regarding the project's method of operation that the Corps' report might recommend. We well consider the recommendations on their individual merits when the time comes.

[12] For instance, should the Corps' report be imminent or issued at the time when we might otherwise be ready to act on the application for license, we might on our own motion decide to consider the implications of the Corps' study before acting on the application.

[13] New Hampshire Fish and Game Department, Vermont Agency of Environmental Conservation, Connecticut Department of Environmental Protection, Massachusetts Division of Fisheries and Game, U.S. Department of the Interior, and the Policy Committee for Fisheries Management of the Connecticut River Basin.

From ???@??? Thu Jul 28 15:05:39 2011
From: Matthew Cole <matthew_cole@transcanada.com>
Date: Thu, 28 Jul 2011 13:05:15 -0600
Subject: RE: Wednesday's walk
To: "Linda L. Fowler" <Linda.L.Fowler@Dartmouth.EDU>

Dear Linda,

We have an active study to document and evaluate riverbank erosion along the Connecticut River in Vermont and New Hampshire from the top of the Wilder Project to the Massachusetts state line. It is still in the data collection phase.

Once drafted, we will review the site-specific information relating to the Pine Park area. We'll be in touch again when the review is completed.

It was a pleasure to meet and talk with you and thank you for your interest.

Thanks,
Matthew Cole
Community Relations, US NE Region
(413) 424-7229

Please consider your environmental responsibility before printing this document.
-----Original Message-----
From: Linda L. Fowler [mailto:Linda.L.Fowler@Dartmouth.EDU]
Sent: Thursday, May 19, 2011 8:01 PM
To: Matthew Cole
Cc: ropeferry@yahoo.com; rbailey@crrel.usace.army.mil; Richard.E.Nordgren@Hitchcock.ORG; aggiebk@gmail.com; Brian F. Kunz
Subject: Wednesday's walk

Dear Matt,
Thanks for meeting with me yesterday to survey the riverbank erosion in Pine Park.
I was pleased to hear that you had done some scouting with Ken last year.

I think that some tree cutting to preserve the root balls and use of the downed
trees to reinforce the bank sounds like a good idea. I am sure the board will
be pleased that you intend to have an expert on riverbank restoration take a look

at it.

I'll be in touch as we agreed in about a month to see what plan you have
come
up with.

Again, thank you on behalf of the Pine Park trustees for taking this
project forward.
Linda

Linda L. Fowler
Professor of Government and Frank J. Reagan Chair in Policy Studies
6108 Silsby Hall
Dartmouth College
Hanover, NH 03755
Tel: 603-646-0009
Fax: 603-646-2152
linda.fowler@dartmouth.edu

From ???@??? Thu May 21 20:21:06 2009
From: Agnes Kurtz <aggiebk@gmail.com>
Date: Thu, 21 May 2009 20:20:34 -0400
Subject: Re: minutes
To: "Linda L. Fowler" <Linda.L.Fowler@dartmouth.edu>
Cc: ropeferry@yahoo.com, rbailey@crrel.usace.army.mil, Richard.E.Nordgren@hitchcock.org, "Brian F. Kunz" <Brian.F.Kunz@dartmouth.edu>

I've talked to Carolyn a few times since the meeting and this is what she could find:
In 1981, there was work done on the bank and it was after a permit from New England Power Co. was granted by George McGee from the water resources board in Concord NH to the people doing the work. Carolyn has minutes stating that "work was done according to flowage agreements between NE Power Co and the abutters (us and others on the conn. river)

And that may be the last time work was done.

(We both looked at minutes from the early 1990'a and we found no mention of work. I do not have a good set of minutes, but I am sure Carolyn does.)

Which begs the question: what is the agreement and who is it between? It would be nice if we could find something with some power company.

I will be away from sat morning to tues morning.

Ag

2009/5/21 Linda L. Fowler <Linda.L.Fowler@dartmouth.edu>

> All--Here are the minutes from last week's meeting. Please note the action
> items in CAPS.
> Cheers, Linda
>

From Linda.L.Fowler@Dartmouth.EDU Thu May 19 20:01:12 2011
To: Matthew_cole@transcanada.com
Subject: Wednesday's walk
Cc: pine park
Bcc:
Date: Thu, May 19, 2011 8:01 PM

Dear Matt,
Thanks for meeting with me yesterday to survey the riverbank erosion in Pine Park. I was pleased to hear that you had done some scouting with Ken last year.

I think that some tree cutting to preserve the root balls and use of the downed trees to reinforce the bank sounds like a good idea. I am sure the board will be pleased that you intend to have an expert on riverbank restoration take a look at it.

I'll be in touch as we agreed in about a month to see what plan you have come up with.

Again, thank you on behalf of the Pine Park trustees for taking this project forward.
Linda

Linda L. Fowler
Professor of Government and Frank J. Reagan Chair in Policy Studies
6108 Silsby Hall
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Fax: 603-646-2152
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MAP
CONNECTICUT
PINE PARK
S

FILL OUT ACCURATELY AND COMPLETELY TO AVOID RETURN AND DELAY

STATE OF NEW HAMPSHIRE

PERMIT NO.__________ DATE__________

APPLICATION FOR PERMIT TO EXCAVATE, DREDGE, FILL, MINE OR CONSTRUCT, IN ANY WATERS OF THE STATE.

Permit Approved/Denied

____
For the Special Board

Application is hereby made for a permit to accomplish work described below relating to excavating, dredging, or filling, in accordance with the Rules and Regulations established under the provisions of RSA Chapters 483-A and 149:8A. One copy of your application will be acted upon by the W. S. P. C. C. and such action will be incorporated in one distribution.

1. Name of Owner New England Power Company (print or type) Telephone No. 617-366-9011

Residence or principal business address 25 Research Drive, Westborough, MA 01581

LOCATION OF PROPOSED CONSTRUCTION

2. Town or City Hanover, New Hampshire County Grafton

3. Project Address East Side of Connecticut River 1 mi. north of Hanover N.H. bridge (street, road, highway)

4. Adjacent to, or in (salt) (fresh) water Connecticut River (name of water body)

5. Type of project - Fill ( ) Dredge ( ) Wharf ( ) Other Maintenance (Specify)

6. Reason(s) for proposed construction: Reconstruction of an existing 12' x 12' pier and the replacement of 1,800' of stone riprap along 7,500' of shore line.

7. (a) Proposed starting date August 17, 1981 (b) Completion date September 30, 1981

8. If work is to be done by self, contractor, or agent, give his name and address below:

Miller Construction Company, Windsor, Vt. Telephone No. 802-674-5525

9. Description of construction (use reverse side for additional information):
   (a) Type of material 18 in. max. rock
   (b) Estimated quantity of dredged material (cu. yd.): N/A
   (c) Estimated quantity of fill material (cu. yd.): 9,000
   (d) Final disposition of dredged material: N/A
   (e) If any channel is to be constructed, the distance the flow of water is to be re-routed: N/A

10. I hereby certify that the applicant has filed three copies of said application with the Town/City of Hanover as required by Chapter 483-A.1 as amended 1973.

DATE Aug 28, 1981 Signature [illegible] Deputy
Town/City Clerk

11. Complete list of all abutting owners, their addresses and phone numbers: (They have been contacted and the work proposed has been explained to them. Note on separate sheet objections raised by abutters)

... of stone riprap along 7,500' of shore line.

7. (a) Proposed starting date August 17, 1981 (b) Completion date September 30, 1981

8. If work is to be done by self, contractor, or agent, give his name and address below:

Miller Construction Company, Windsor, Vt. Telephone No. 802-674-5525

9. Description of construction (use reverse side for additional information):
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   (b) Estimated quantity of dredged material (cu. yd.): N/A
   (c) Estimated quantity of fill material (cu. yd.): 9,000
   (d) Final disposition of dredged material: N/A
   (e) If any channel is to be constructed, the distance the flow of water is to be re-routed: N/A

10. I hereby certify that the applicant has filed three copies of said application with the Town/City of Hanover as required by Chapter 483-A.1 as amended 1973.

DATE Aug 28, 1981 Signature Sandra L. [illegible]
Town/~~City~~ Clerk Deputy

11. Complete list of all abutting owners, their addresses and phone numbers: (They have been contacted and the work proposed has been explained to them. Note on separate sheet objections raised by abutters).

This work is being done in accordance with flowage agreements between New England Power Company and certain abutters. These agreements stipulated that New England Power Company would install and maintain bank protection in this area.

A permit issued under this application shall be non-transferable and shall expire two year from date of issue.

Edward A. Plumley

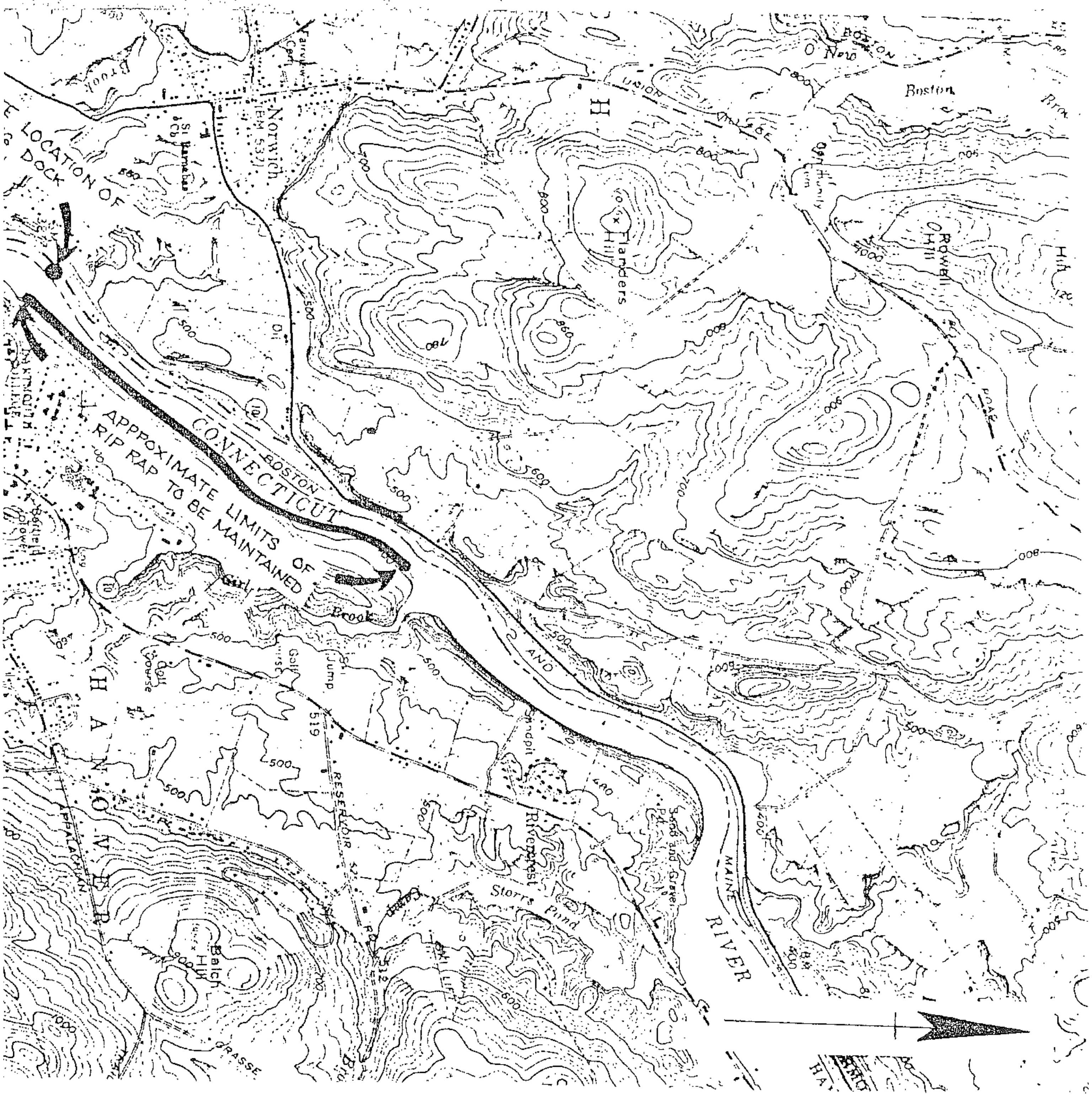
Signature of Owner or Authorized Agent [signature]

Date August 24, 1981

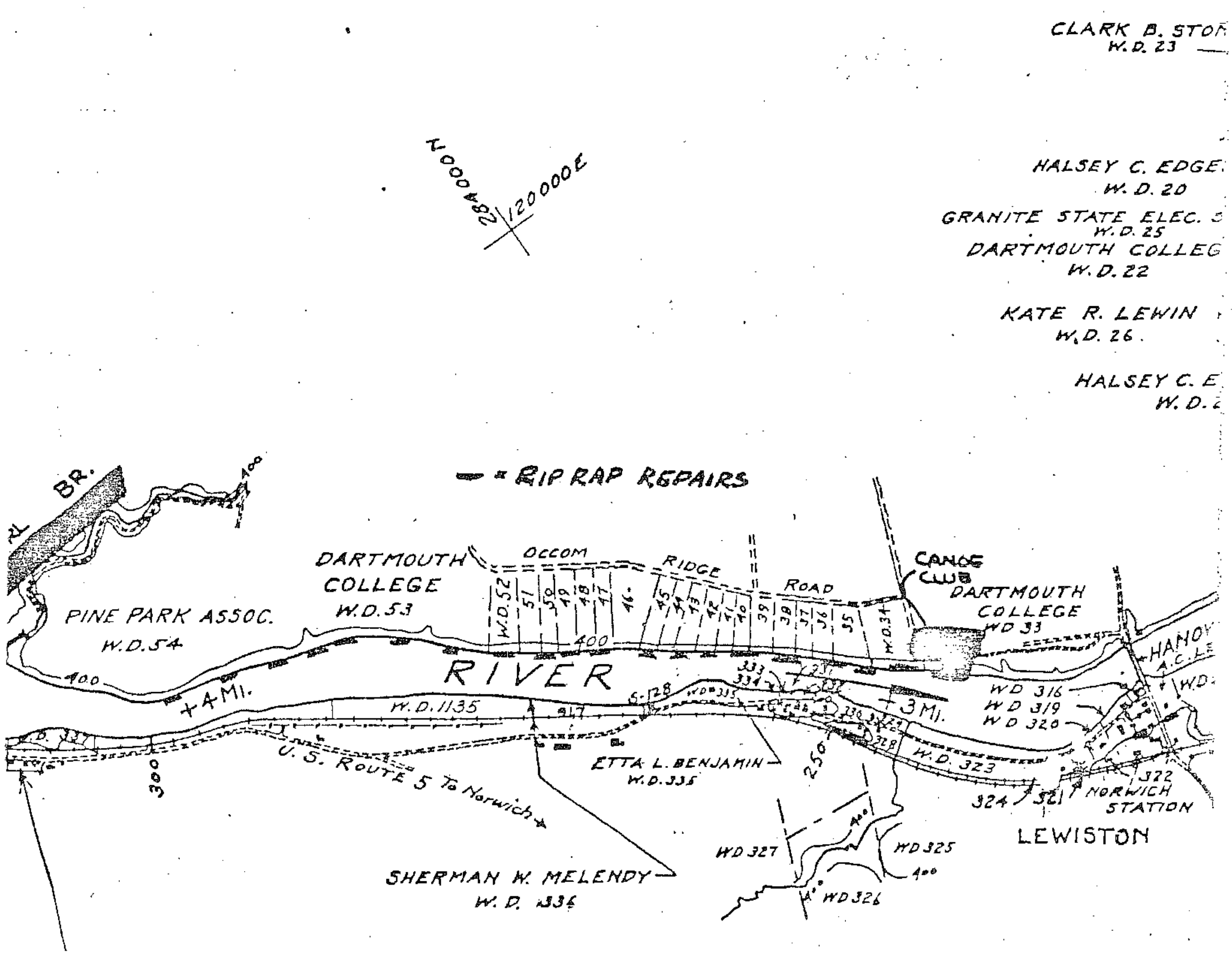
Vice President
New England Power Company

SEE REVERSE SIDE FOR INSTRUCTIONS

Rev. 8/3 /76



APPROXIMATE LIMITS OF
RIP RAP TO BE MAINTAINED
CONNECTICUT
RIVER
Norwich
Flanders Hill
Rowell Hill
Storrs Pond
Balch Hill
HANOVER



CLARK B. STOR
W.D. 23
HALSEY C. EDGE
W.D. 20
GRANITE STATE ELEC.
W.D. 25
DARTMOUTH COLLEG
W.D. 22
KATE R. LEWIN
W.D. 26.
HALSEY C. E
284000N
120000E
= RIP RAP REPAIRS
BR.
DARTMOUTH COLLEGE W.D. 53
PINE PARK ASSOC. W.D. 54
OCCOM RIDGE ROAD
W.D. 52
51
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45
44
43
42
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36
35
W.D. 34
CANOE CLUB
DARTMOUTH COLLEGE WD 33
RIVER
400
+4 MI.
+3 MI.
W.D. 1135
S-128
WD 335
333
334
331
WD 316
WD 319
WD 320
W.D. 323
ETTA L. BENJAMIN W.D. 335
U.S. ROUTE 5 To Norwich
SHERMAN W. MELENDY W.D. 336
300
250
324
321
322
NORWICH STATION
LEWISTON
WD 327
WD 325
WD 326

TWO RIVERS-OTTAUQUECHEE
REGIONAL COMMISSION
William B. Emmons, III, Chairman
Peter G. Gregory, AICP, Executive Director

March 1, 2013

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, D.C. 20426

RE: Comments on Scoping Document 1 and requests for studies pertaining to relicensing application for **Wilder Project No. 1892-026**.

Dear Ms. Bose,

The Two Rivers-Ottauquechee Regional Commission appreciates the opportunity to provide comments and submit study requests regarding TransCanada's application to relicense the Wilder dam, Project No. 1892-026.

Our organization is an association of thirty municipalities in east-central Vermont. We provide technical services and assistance to local, state and federal levels of government, as well as to various organizations and businesses throughout the region. The two primary goals of our organization are to advocate for the needs of our member towns, and to articulate a vision for building a thriving regional economy while enhancing the region's quality of life.

We would like to mention that, despite our criticisms of the Wilder dam, we recognize that it is a source of renewable energy and provides opportunities for recreation. Our intent is to truly understand the implications, good or bad, of current operations and future alternatives.

We provide the following comments at this time for the TransCanada relicensing application process:

1. *It is unclear after reading the Scoping Document 1 (SD1) what TransCanada's proposed action for the Wilder project is, or if a proposed action has even been decided*.

The Scoping Document 1 does not make clear the action TransCanada anticipates will become their proposed action in the relicensing process. Section 3.2 of SD1 provides details on the Wilder facilities and operating regime, while section 3.4.2.1 outlines the current license requirements and voluntary measures. Scoping Document 1, section 3.2, Dec 2012, p. 9; section 3.4.2.1, p. 14-16. According to section 3.4.1, "[a]t this time, TransCanada is not proposing any changes to the licensing project facilities or operation at the Wilder… project." Scoping Document 1, section 3.4.1, Dec. 2012, p. 14. Does this mean that section 3.2, the current operation of the Wilder dam, will become TransCanada's proposed action? Will the current license requirements listed in 3.4.2.1 still remain part of the license requirements? Will the voluntary measures remain voluntary or will they become part of the license requirements (and proposed action) as well? The answers to these questions are unclear and not easily discerned from SD1. If we need to be asking these questions, it may seem as though TransCanada has not proposed any action yet, or their intentions are hidden from SD1's intended audience.

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802.457.3188, fax: 802.457.4728, www.trorc.org

If TransCanada has not yet decided on a proposed action, then this scoping process seems premature, as the purpose of the process is to gather initial comments about TransCanada's intended actions. Along the same lines, if TransCanada determines that a different action will be pursued under the assertion that upgrades to the facilities or operations "will continue to be evaluate[d]," the scoping process should begin again to allow the public to comment on that action, and request studies or information with these different set of circumstances in mind. Scoping Document 1, section 3.4.1, Dec. 2012, p. 14. Otherwise, TransCanada could gather comments and build a record based upon one action, and with the knowledge that issues or concerns not raised in the public comment process are not required to be considered thereafter, could change their mind and pursue a different option without being required to address the public's concerns.

2. *The scoping document disregards pre-dam conditions for purposes of evaluating and determining baseline environmental conditions for selected alternatives.*

In section 3.1, SD1 uses the "no-action alternative," or no change from the current operating conditions, as the environmental baseline of comparison for any other alternatives that are developed. Using a presently disturbed and degraded environment as a means for comparison of future environmental degradation perpetuates environmental degradation and destruction. It is somewhat surprising that SD1 treats the Connecticut River as if it is a body of water that has never been free-flowing.

A close reading of *American Rivers v. FERC II*, while not binding on any decision or action on the East Coast, demonstrates that FERC is not required to examine pre-dam conditions when selecting an environmental baseline, but that this type of examination is not precluded either. *American Rivers v. Fed. Energy Reg. Comm'n*, 201 F.3d 1186, 1186-1211, (9th Cir. 2000). In fact, FERC admitted, and the court agreed, that "… the adoption of an existing project baseline does not preclude consideration and inclusion of conditions in a license that enhance fish and wildlife resources and reduce negative impacts attributable to a project since its construction." *Id*. at 1198. With that in mind, why is the current environmental impact of the operation of the dam being used as the environmental baseline? When it comes to the Wilder dam, a number of environmental concerns and issues will not be looked at if this method of comparison is implemented.

Any environmental resource issue, including the ones raised by FERC in section 4.2 of the SD1, would be better understood in the context of the environmental damage caused by the dam's current operation if the baseline was set before the dam was ever constructed. The current operation of the Wilder dam is impacting the environment and aquatic ecosystems, from river bank erosion, to disruption of the natural mitigation patterns of native fishes (even with fish ladders), as well as, affecting the natural migration of sediment down the River, and the natural temperature regimes that existed in the River before the dam construction. FERC has recognized that it is important during the relicensing process to take steps to mitigate these types of environmental effects as a result of dam construction and maintenance. *Id*. The true extent of impacts will only be illuminated if FERC analyzes each alternative proposed in this application process against the conditions that existed in the Connecticut River before any dams were constructed.

3. *The assertion in section 3.6.3 of SD1 that "No party has suggested project decommissioning…" is anticipatory and preemptive, considering the fact that the assertion was made before SD1 was released for comment.*

In section 3.6.3 of SD1, FERC asserts that decommissioning will not be studied because "No party has suggested project decommissioning…" Scoping Document 1, section 3.6.3, Dec. 2012, p. 22.

However, when SD1 had been written, no party had suggested decommissioning as an alternative because the scoping document had not yet been circulated for comment. It seems as though FERC anticipated that no party would suggest decommissioning as an option before most parties were alerted that the relicensing application process would begin. Under the Federal Power Act, FERC must also consider non-power values, such as environmental quality, wildlife and recreation considerations when deciding whether to relicense a project. Federal Power Act, 16 U.S.C. § 797(e). The alternatives advanced by FERC are focused on power generation only. While only in the beginning stages of the relicensing application process, FERC's preemptive statement seems counter to their statutorily mandated duty to consider purposes other than power generation, including the possibility of decommissioning.

4. *We would like FERC to consider decommissioning as an alternative action to relicensing the Wilder dam.*

The Two Rivers-Ottauquechee Regional Commission proposes that FERC consider decommissioning the Wilder dam as an alternative action, either by ceasing operation of the dam or by removing the dam. FERC did not provide a sufficient or well-reasoned explanation for its decision to eliminate the "decommissioning" alternative from further detailed study. We would like FERC to explain on what grounds it was determined that decommissioning was inappropriate or not recommended for the Wilder dam. Furthermore, use of decommissioning and removal, which are possible outcomes, is a very good means to illuminate the impacts of continued operations in the alternatives analysis. Lastly, it is not clear if any funds are held in trust for decommissioning, and the amount of funds that would be needed for such a project. We recognize that decommissioning is unlikely to be the end result, but believe that at a minimum, such an understanding of decommissioning may be useful.

5. *The list of resource issues identified by FERC staff in section 4.2 of SD1 does not match the studies proposed by TransCanada in Table 1, and we are unclear if TransCanada will be required to address those issues*.

The Federal Energy Regulatory Commission staff identified and categorized a number of resource issues in section 4.2 of SD1. However, of all the resources issues that have been identified, TransCanada has only proposed one water resources study and one cultural resources study. Scoping Document 1, Table 1, Dec. 2012, p. 30. We are unsure if TransCanada will be required to study the resource issues identified by FERC, or if they will be left to their own volition to decide which resource issues to study further. **We strongly agree with FERC that the issues identified need to be studied. We request that TransCanada be required to study at least each issue identified in section 4.2 before FERC considers relicensing their hydroelectric projects.**

6. The effect of the projects' operation and maintenance on river bank erosion and soil resources should be added to the list of resources cumulatively affected.

We recognize that soil resources and river bank erosion were slated to be analyzed for cumulative impacts in section 4.2.1, since they are marked with an asterisk. However, soil resources were not listed in section 4.1.1, which is an overview of the resources thought to be cumulatively impacted by the dams.

Constant water level fluctuation is a major contributor to river bank erosion. *Connecticut River Streambank Erosion Study*, Prepared for U.S. Army Corps of Engineers, Contract No. DACW 33-78-C-0297, Nov. 1979 p. 158. According to SD1, there are five hydroelectric projects located on the main stem of the Connecticut River, between river miles 262 and 122. Scoping Document 1, section 4.1.2, Dec. 2012, p. 23. It is conceivable that, when viewed holistically, the effects of the operation and maintenance of each of the five projects addressed by FERC in this scoping document would cumulatively affect the Connecticut River's banks. It is surprising that FERC did not automatically consider soil resources a resource that could be cumulatively affected by dam operation.

As such, we would like to recommend that soil resources be analyzed for cumulative effects. We believe that a geographic beginning in Newbury, the northern-most town in our region that abuts the Connecticut River, and extending south to the Turner's Dam in Massachusetts is appropriate. This scope would incorporate a sufficient number of river miles upstream of the Wilder dam, and include the other four projects located on the main stem of the Upper Connecticut River.

7. *There is a discrepancy in the hydraulic capacity calculations of the turbines at the Wilder facility*.

According to section 3.2.1.1, outlining the facilities at the Wilder dam, there are three turbines present. Scoping Document 1, section 3.2.1.1, Dec. 2012, p. 9. When the hydraulic capacities of all three turbines are added together, the hydraulic capacity of the Wilder facility is approximately *12,700 cfs*. However, section 3.2.1.2, focused on the operations of the Wilder dam, states that the facilities' "approximate full hydraulic capacity [is] *10,700 cfs*." Scoping Document 1, section 3.2.1.2, Dec. 2012, p. 9. There is a discrepancy of 2,000 cfs between these two sources of information. This discrepancy should be reconciled and clarified in subsequent documents.

8. *There is a discrepancy in the draw-down elevations between the description of draw-down in the Wilder facilities section and current license requirements.*

Section 3.2.1.1 states that the full pond elevation of the Wilder dam is 384.5 feet mean sea level (msl). Scoping Document 1, section 3.2.1.1, Dec. 2012, p. 9. According to the current license requirements in 3.4.2.1, TransCanada must limit their draw-down to five feet, or to "elevation 380 feet." Scoping Document 1, section 3.4.2.1, Dec. 2012, p. 15. If the full pond is elevation 384.5 feet, then a five foot draw-down would be to elevation 379.5 feet, not elevation 380 feet. This discrepancy should be reconciled and clarified.

9. *In the current license, FERC seems to recommend that an additional turbine be installed when market conditions warrant.*

The current operating license for the Wilder dam states that an additional turbine may be installed, and such an addition would be "feasible." Project No. 1892 Operating License, Fed. Energy Reg. Comm'n, Issued Dec. 10, 1979, p. 6-7. To our knowledge, TransCanada has not pursued the addition of another turbine, and nothing in SD1 alludes to it. We must assert that the installation of an additional turbine, while in the current operating license, is a significant upgrade to the Wilder facility. It should not be considered in the "no-action" (current operations) environmental baseline that FERC seeks to use. If the addition of a turbine is pursued, it should be treated as a major upgrade and trigger a full environmental impact statement. We take no position on such an installation, but it seems on its face that since the dam is in place and proposed to continue, that it should be known if it can produce more power and the impacts of such production.

10. *In future relicensing documents, FERC should address emergency management considerations and information gathered from dam break inundation modeling.*

Although not discussed in SD1, future relicensing documents should include a discussion of emergency management procedures for the Wilder dam. The dam break inundation modeling completed primarily for the Moore dam at Fifteen Mile Falls and dams downstream should be addressed and discussed as it relates to the Wilder dam. FERC should consider who received this information, and whether the information has been distributed to a sufficient number of emergency management personnel so that an emergency can be dealt with as best as possible. FERC may also consider whether trainings are necessary in order to prepare crews for the circumstances that may occur during a dam break emergency.

11. *The Pre-Application Document undervalues or ignores the effect of pool fluctuations on river bank erosion, and misrepresents the 1979 U.S. Army Corps of Engineers River Erosion Study*.

According to the 1979 U.S. Army Corps of Engineers River Erosion Study, pool fluctuations are the second most erosive variable when analyzing river bank erosion, the most erosive variable being shear stress. *Connecticut River Streambank Erosion Study*, Prepared for U.S. Army Corps of Engineers, Contract No. DACW 33-78-C-0297, Nov. 1979, Table 2, p. 81. The other variables studied in the 1979 study were: flood variation, stage variation, wind waves, boat waves, freeze-thaw, ice, seepage forces, and gravitational forces. *Id*. p. 81-92. However, the Pre-Application Document (PAD) states that the "Project's Operations [of "modest daily pond fluctuations"] would not likely be a significant contributor to erosion in the reservoir compared to naturally occurring [processes]." TransCanada Hydro Northeast Inc., Wilder Hydroelectric Project, FERC Project No. 1892, Pre-Application Document, Oct. 2012, p. 3-14. The PAD goes on to say that the daily cycle, "run-of-the-river" mode, leads to a "modest" 2.5 feet change in elevation (382.0 feet (msl) and 384.5 feet (msl)), and that TransCanada is actually operating the dam in a way that produces less pool fluctuation than is authorized under the current license (380.0 feet (msl) and 385.0 feet (msl)). *Id*.

TransCanada seems to conveniently ignore the findings of the 1979 study by couching the reduced pool fluctuations at the Wilder dam as "not likely" being a significant contributor to river bank erosion (even though the pool fluctuates approximately 2.5 feet each day). The current pool fluctuations may not be "significant," but that does not mean that they are in any way an *insignificant* force on river bank erosion. As previously mentioned, the 1979 study determined pool fluctuation to be a significant variable on bank erosion, yet TransCanada disregards that finding when it does not support their desired operations. In fact, when listing the causes of erosion in the PAD ("recession of high water levels following spring melts and storm events, freeze-thaw and wet-dry cycles, ice and debris, surface run-off of rainwater, removal or loss of vegetation, obstacles in the river, and waves and boat wakes."), man-made pool fluctuations, like dam operations, are markedly absent. TransCanada Hydro Northeast Inc., Wilder Hydroelectric Project, FERC Project No. 1892, Pre-Application Document, Oct. 2012, p. 3-13—3-14.

In addition, the PAD claims the 1979 study concluded that the river banks would erode "with or without the Project," and normal operation of the dam is not a "significant contributor to erosion in the reservoir." TransCanada Hydro Northeast Inc., Wilder Hydroelectric Project, FERC Project No. 1892, Pre-Application Document, Oct. 2012, p. 4-2. There is no question river bank erosion would occur without the dam. However, TransCanada considers the ability of the dam's operation to erode the river banks to be insignificant, while the 1979 study determines this exact type of variable to be a powerful erosive force. If the 1979 study is used to support some of TransCanada's positions, then the study should not be ignored when it does not support other positions, but rather used as a stimulus to develop solutions to mitigate river bank erosion.

The following are the study request subject areas.

- Comprehensive recreation and river access study.
- Economic activity generated by recreation associated with the river, adjacent lands and parks in the project area.
- Erosion of river bank soils.
- Impacts of decommissioning.

Requests for Study

1. Comprehensive Recreation and River Access Study

1. This study should be categorized under "Recreation" in the resource issues section. The goals of this study are: to determine the need for (and extent of) recreation on the Connecticut River in the project area, to determine and evaluate opportunities for public river access, to determine the public's vision of recreational opportunities, and to assess areas that would be suitable for additional camp sites, canoe/kayak portages, public access areas, fishing and bird-watching areas, and ADA-accessible areas. Finally, the study should evaluate options for enhancing pre-existing access sites.

2. The Federal Power Act requires that non-power values are given consideration during the licensing process. Federal Power Act 16 U.S.C § 797(e). Here, recreation is a public use of the Connecticut River.

3. A number of relevant public interest considerations inform this study. For example, the demographics of area have changed over time, and there is a greater desire for and high value placed on water-dependent recreational opportunities among local residents and tourists. As such, public recreation areas and river access areas are an asset to towns located along the Connecticut River, and could provide potential economic benefits to adjacent towns and communities.

4. According to SD1, TransCanada's current license requires them to operate and maintain 8 recreational facilities: 1 car-top boat launch, 2 boat ramps, 2 angler access areas, 1 dock, 1 portage trail, 1 water trail campsite, 2 picnic areas, 1 natural area, a network of hiking trails, an athletic field. However, there is a need for additional information because it is important to understand the recreational opportunities that currently exist, and compare these against the public's opinion and/or view of desired and feasible recreational opportunities.

5. Dams create impediments to some water-dependent recreation by necessitating portages and limiting free-flowing water. They also increase flat-water recreation opportunities and can create park and access areas. The damming of the Connecticut River provides an impediment for those wanting to canoe or kayak long distances north or south on the River. The Connecticut River is a public trust resource and the public's ability to use and enjoy the River in some ways is

diminished by the current and any future operation of TransCanada's dams. As such, TransCanada should better accommodate the public's desire to use the River as a recreational destination. Results that may show a lack of recreational opportunities and/or the public's desire for additional opportunities along the River, including, but not limited to, portages around dams and/or other impoundments, river access points for fishing, boating and/or canoeing/kayaking, connection(s) to nearby hiking trails, and campsites could be used to require investment in creating recreational opportunities. In addition, results demonstrating that existing opportunities need to be enhanced or upgraded, either by data collected from the user survey or facilities inventory, could be written into TransCanada's future dam operation license to require investment in enhancing facilities.

6. We believe that a recreational use/user contact survey could be conducted to establish the amount of recreation use and user opinion of current and potential recreational opportunities on the stretch of the Connecticut River from Hartland north to Newbury. A recreational facilities inventory and assessment should also be conducted to evaluate all recreational facilities. In order to understand future recreational areas, a suitability survey of sites should be conducted. The survey may assess the suitability of sites for future development as an additional access point/camp site/ portage/ADA-accessible area or connection to other recreational opportunity.

7. We anticipate that this study will cost $80,000. The proposed alternatives would not be sufficient because there are currently no proposed studies that focus on recreational and river access opportunities. This study could be combined with the study below as well.

2. Study on the Economic Activity Generated by Recreational Activity in the Project Area

1. This study should be categorized under "Socioeconomic Resources" in the resource issues section. The goals of the study should be: to understand the current and potential economic activity generated by recreationalists in the project area, including in the parks created as a result of dam construction and continued operation and at lands managed by TransCanada, to analyze the direct and indirect economic benefits to local towns and communities as a result of activities occurring at these parks, TransCanada lands or recreational facilities, and to develop strategies that towns can use to promote park use while also educating the public about dam operation.

2. One of the goals of the managing the Connecticut River is to provide numerous opportunities for leisure and recreation, while providing benefits to the surrounding communities.

3. The parks adjacent to dams provide space for festivals, performances and other activities. These parks also provide residents and visitors with opportunities for outdoor activities and recreation. Other various activities such as sculling competitions, riverfront camping, paddle sports, motor boating, fishing and bird watching all have economic impacts.

4. To our knowledge, there is no existing information related to this topic. Therefore, there is a need to understand the economic benefit of that these recreational assets provide, as this information would provide important insight into the overall impacts of the dam's continued operations, as well as associated lands owned or managed by TransCanada.

5. The creation of the parks and recreational facilities has encouraged public activities at these sites, and has likely created economic benefits for surrounding communities. Thus, the economic activity generated by these lands and facilities is an incidental result of dam construction and operation. Better facilities or access points for portages, hiking trails, fishing, and ADA-accessible areas, among others would also produce economic activity. Once the information from this study has been released, TransCanada may be required to provide connections from parks, recreational facilities to town centers to encourage travel between the various destinations.

6. We are not proposing any specific study methodology.

7. We believe this study would cost $75,000. The proposed alternative studies would not be sufficient because there are currently no studies proposed that focus on this topic.

3. River Bank Erosion Study

1. This study should be categorized under "Geology and Soil Resources" in the resource issues section. The goals of this study include determining the causes of river bank loss, including determining and quantifying the estimate of river bank loss due to dam operations; quantifying the loss of high-quality agricultural soils and eroded town properties, and mapping the extent of areas needed to stabilize the river banks. In addition, it is important to determine and quantify the benefits of pool fluctuations. Finally, the study should seek to evaluate solutions that will mitigate or slow the loss of river bank, such as dam management strategies, revegetation, bank grading and armoring, among others.

2. Preservation of prime farm lands, roads, and stable rivers are public goods.

3. Farmers owning land abutting the Connecticut River have reported losing cropland as a result of erosion, and the erosion is ongoing. High quality agricultural soils are disappearing, and are a vital resource that helps to sustain the local community. This erosion also results in sediment and nutrient water quality impacts. River bank erosion not only impacts agricultural lands, but also private property, town owned property and riparian ecosystems.

4. There is information that exists which addresses this topic, and can be found in the 1979 U.S. Army Corps of Engineers Connecticut River Erosion study, however it is somewhat dated. Therefore, we believe there is a need for updated information. We need to understand and quantify the amount of erosion caused by "natural" processes and the amount caused by the

operation of the dam instead of using vague and inexplicit language to describe the causes of erosion above the Wilder dam, and understanding the more localized causes of erosion will better inform the process of developing mitigation strategies.

5. The elevation maintained by Wilder dam saturates soil, leading to erosion. As the 1979 U.S. Army Corps of Engineer's study explained, river bank erosion behind a smaller dam, like the Wilder dam, is greater than behind a larger dam, due to the greater fluctuations in water level. The continuous raising and lowering of water level behind Wilder dam exacerbates soil erosion. Finally, TransCanada's PAD assesses some responsibility for river bank erosion on agricultural practices, while undervaluing the impacts of reservoir pool fluctuation on erosion. The study proposed could help sort out and quantify the causes of erosion. Where is it found that bank erosion is exacerbated by dam operation, TransCanada should be required to change or modify its operations to mitigate erosion. The owners may also be required to pay money into a fund for farmers or town to offset this damage, or purchase additional land or easements to the extent needed to stabilize the banks.

6. We are not proposing any specific study methodology, but this is no doubt a matter that has been studied elsewhere since 1979.

7. We estimate that the cost of this study will be $400,000. There are currently no proposed studies that focus on river bank and agricultural soil erosion.

4. Comprehensive Decommissioning Study

1. This study should be categorized under "Developmental Resources" in the resource issues section. The goals of this study should be: to determine the economic impacts of decommissioning the Wilder dam, including, but not limited to, impacts on TransCanada, on the local communities, on the regional economy; to determine the environmental impacts of decommissioning and/or removing the Wilder dam, not only on the river but on sources replacement power. The study should determine the recreational and environmental impacts of decommissioning and/or removing the Wilder dam. Lastly, the study should determine the Wilder dam's anticipated lifetime and the point at which decommissioning is required, evaluate the costs of decommissioning and removal of the Wilder dam, and evaluate the corporation's capacity to finance the decommissioning of the dam and/or remove the dam infrastructure.

2. The Wilder dam should be managed throughout its lifetime, from cradle to grave. A thoughtful decommissioning versus and unplanned decommissioning would provide many benefits.

3. There are a number of public interest considerations that are tied to the future decommissioning of the Wilder dam, including the fact that the dam provides hydropower to the grid. Residents and visitors have also become accustomed to the recreational opportunities found on the Wilder dam reservoir, such as boating, fishing, and canoeing/kayaking. We believe

that local economies may suffer temporarily if recreationalists and festival-goers no longer use the River in the same capacity as they once did, if dam infrastructure is completely removed. This removal would change the area from a lake-like body of water to a much shallower free-flowing stream. Lastly, the region and town and communities adjacent to the Connecticut River will suffer if TransCanada cannot afford to decommission the dam or it becomes insolvent. TransCanada is a corporation, and there is no guarantee that they will be solvent when the time comes to begin the decommissioning process. It is possible that local communities or the state would be left with the responsibilities that come with decommissioning a dam.

4. To our knowledge, there is no information that exists on the topic of decommissioning. Our hope is that this data and information will help TransCanada plan for the future of the Wilder dam and inform the size of decommissioning funds.

5. The Wilder dam will not last in perpetuity, and at some point decommissioning will need to be discussed. In the license, FERC may require TransCanada to begin placing capital in a decommissioning account that can be used when the dam is decommissioned.

6. We are not proposing any specific methodology.

7. We believe this study could be conducted with a budget of $100,000. The proposed alternative studies would not be adequate because there are currently no studies proposed, to our knowledge, that focus on decommissioning.

We appreciate the opportunity to provide our input. Please contact me if you have any questions.

Sincerely,

Peter G Gregory

Peter Gregory, AICP
Executive Director
Two Rivers-Ottauquechee Regional Commission
128 King Farm Road
Woodstock, Vermont 05091
802-457-3188

United States Department of the Interior

FISH AND WILDLIFE SERVICE

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In Reply Refer To: TransCanada Hydro Northeast Inc. March 1, 2013
Vernon Hydroelectric Project, FERC No. 1904
Bellows Falls Hydroelectric Project, FERC No. 1855
Wilder Hydroelectric Project, FERC No. 1892
Connecticut River
COMMENTS ON PRE-APPLICATION DOCUMENT
STUDY REQUESTS
SCOPING DOCUMENT 1

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E., Room 1A
Washington, DC 20426

Dear Secretary Bose:

This responds to the Pre-Application Documents (PADs) for the Vernon, Bellows Falls and Wilder projects, located on the Connecticut River in Vermont and New Hampshire. The PADs are being provided in preparation of applications for new federal licenses for the projects. We offer the following comments based on the PADs (submitted to us by TransCanada Hydro Northeast Inc. [TransCanada] on October 30, 2012) and information we obtained at the site visits and joint agency meetings held on October 1-3, 2012 and the Federal Energy Regulatory Commission (Commission) scoping meetings held on January 29 and 31, 2013.

PRE-APPLICATION DOCUMENTS

PROPOSAL

<u>Vernon Project</u>

The Vernon Project is located in Cheshire County, New Hampshire and Windham County, Vermont. Project works include a 956-foot-long, 58-foot-high dam with the spillway portion made up of a trash sluice, tainter gates, hydraulic flashboard bays, and stanchion bays. The dam impounds 26 miles of river and the Vernon headpond encompasses 2,550 acres. The powerhouse is integral with the dam and contains six vertical Francis and four vertical Kaplan turbine-generator units. The turbines range in size from 2.5 MW to 4.2 MW. Units 1-4 have a maximum hydraulic capacity of 1,465 each (minimum hydraulic capacity was not specified), units 5-8 have a maximum hydraulic capacity of 1,800 cfs each (minimum capacity of 900 cfs), and units 9 and 10 have a maximum hydraulic capacity of 2,035 cfs each (minimum capacity of 900 cfs). The total installed capacity of the project is 32.4 MW and the total hydraulic capacity is 17,130 cfs.

The intake to the powerhouse is covered with two sets of trashracks; racks over units 9 and 10 are spaced 4 inches on center, and racks over units 1-8 are spaced 2 inches on center.

The project operates as a peaking facility when flows are within the hydraulic capacity of the station, with allowable headpond fluctuations of up to eight feet (from elevation 212.0 feet msl to 220.0 feet msl). The project is required to release a minimum below-project flow of 1,250 cfs, or inflow (whichever is less). In 1998, the station was automated, with operations controlled from TransCanada's Connecticut River Control Center in Wilder, Vermont.

The project operates both upstream and downstream fish passage facilities. The facilities include an upstream anadromous fish ladder located on the bank side of the powerhouse and two downstream fish bypasses (a partial depth louver array and fishway pipe located between units 4 and 5, and a smaller fish bypass located on the far west side of the powerhouse).

Average annual generation for the Vernon Project was 131,516 MWh for the period 1982 to 2011.

<u>Bellows Falls Project</u>

The Bellows Falls Project is located in Cheshire and Sullivan counties, New Hampshire and Windham and Windsor counties, Vermont. Project works include a 643-foot-long, 30-foot-high dam with the spillway portion made up of roller-type flood gates and stanchion bays. The dam impounds 26 miles of river, and the Bellows Falls headpond encompasses 2,804 acres. The powerhouse is located at the end of a 1,700-foot-long canal and contains three vertical Francis turbines. Each turbine has a rated capacity of 16 MW and a maximum hydraulic capacity of 3,670 cfs (minimum hydraulic capacity of 1,300 cfs). The total installed capacity of the project is 40.8 MW.

The intake to the powerhouse is covered with trashracks that have clear spacing of 4 inches. The project operates as a peaking facility when flows are within the hydraulic capacity of the station, with allowable headpond fluctuations of up to 3 feet (from elevation 288.6 feet msl to 291.6 feet msl). The project is required to release a minimum below-project flow of 1,083 cfs, or inflow (whichever is less). In 1998, the station was automated, with operations controlled from the Connecticut River Control Center in Wilder, Vermont.

The project bypasses 3,700 feet of the Connecticut River. There is no required flow in the bypass reach. The project operates both upstream and downstream fish passage facilities, including an upstream anadromous fish ladder located on the bank side of the powerhouse and a downstream fish bypass (a partial depth diversion boom across the canal and sluiceway/skimmer gate located on the island side of the canal, upstream from the powerhouse).

Average annual generation for the Bellows Falls Project was 242,829 MWh for the period 1982 to 2011.

Wilder Project

The Wilder Project is located in Grafton County, New Hampshire and Windsor and Orange counties, Vermont. Project works include a 59 foot-high dam with a 526-foot-long spillway portion made up of tainter gates and stanchion bays. The dam impounds 45 miles of river and the Wilder headpond encompasses 3,100 acres. The powerhouse is integral with the dam and contains two adjustable Kaplan turbine-generator units and one vertical Francis turbine-generator unit. The two Kaplan turbine-generators are rated at 16.2 MW each and the Francis turbine generator has a nameplate rating of 3.2 MW. The operating range of the Kaplan units is from 1,000 cfs up to 6,000 cfs (each), while the Francis unit is fixed at 700 cfs.

The intake to the powerhouse is covered with trashracks that have clear spacing of 5½ inches. The project operates as a peaking facility when flows are within the hydraulic capacity of the station, with allowable headpond fluctuations of up to 5 feet (from elevation 380.0 feet msl to 385.0 feet msl). The project is required to release a minimum below-project flow of 675 cfs, or inflow (whichever is less). In 1998, the station was automated, with operations controlled from TransCanada's Connecticut River Control Center in Wilder, Vermont.

The project operates both upstream and downstream fish passage facilities. There is an upstream anadromous fish ladder with both a spillway and turbine entrance. Downstream fish passage is provided by the existing log sluiceway located between unit no. 3 and the fish ladder entrance gallery and spillway.

Average annual generation for the Wilder Project was 153,738 MWh for the period 1982 to 2011.

All Projects

TransCanada is not proposing any new facilities as part of this relicensing and also is not proposing any additional protection, mitigation and enhancement (PME) measures.

COMMENTS

2.3.2 Powerhouse Features

Vernon Project

TransCanada states that the Turners Falls impoundment backwaters to the base of Vernon Dam. According to FirstLight (owner of the Turners Falls Project), the Turners pool does not extend to the base of Vernon Dam.

All Projects

While TransCanada provides the spacing of the trashracks, it does not specify the dimensions of the racks (wetted area). This information is needed so that the agencies can calculate the average approach velocities to the racks.

2.5.2 Normal Operations

All Projects

In the PADs, TransCanada states that the projects are operated on a daily run-of-river basis. While technically the projects may pass the daily inflow over the course of a day, a more accurate description of the mode of operation is peaking, whereby the projects generate at maximum capacity for a period of hours and only pass the required minimum flows for the remainder of the day.

3.1 Introduction

Vernon Project

TransCanada states that in the PAD, the term "Vernon Project affected area" refers to Vernon dam to the upstream extent of the Vernon impoundment. As we noted earlier, FirstLight has indicated that according to a recent water surface elevation survey, the Turners Falls pool does not extend to the base of Vernon Dam; therefore, Vernon operations do impact the Connecticut River some distance downstream of the dam.

3.4.5 Reservoir Shoreline and Streambanks

Vernon Project

TransCanada indicates that typically headpond levels are kept between 218.6 feet msl and 219.8 feet msl, although the licensed range is between 212.13 feet msl and 220.13 feet msl. In addition, the stanchion and hydraulic flashboard sill elevations are given as 220.13 feet msl. This information conflicts with data provided earlier in the PAD; in Table 2.1-1, the operating range is given as 212.0 to 220.0 feet msl and Table 2.3-1 lists the flashboard and stanchion elevations as 212.13 feet msl.

In this section of the PAD, TransCanada also refers to a number of surveys conducted on the eastern riverbank downstream of Vernon Dam. According to TransCanada, the results of those surveys identified two major causes of the changes to the riverbank, one being the higher interface between the bank and the river due to the raising of the Turners Falls impoundment elevation in the mid-1970s.

As stated previously, FirstLight now contends that the Turners pool does not extend up to Vernon Dam. This conflicting information needs to be clarified and resolved, as it has bearing on both projects.

3.5.2 Hydrology

Drainage Area

All Projects

In this section and in others, TransCanada specifies that it has a self-imposed drawdown rate of 0.3 feet per hour. While this may be the case during normal operations, it is unclear if this same drawdown rate can be maintained when TransCanada needs to lower the headpond down to the concrete crest in order to replace the stanchion beams. Drawdown rates during these events need to be clarified.

Project Inflow and Outflow

All Projects

Figure 3.5-6 shows hourly outflow from the three stations from 2001 through 2011, although as presented, the data are compressed. By compressing these data, it is difficult to see the actual daily fluctuations in flow below the project. Likewise, the box and whisker graphs in Figure 3.5-1 are helpful in understanding the highest and lowest headpond levels at the projects from 2001 through 2011, but they do not provide a representation of the magnitude and frequency of daily headpond variations.

Because the information in the PADS does not provide the level of detail necessary to fully understand how the projects operate individually and together with TransCanada's other projects, we are requesting that TransCanada provide hourly data (water surface elevations, gate discharges, generation) from all projects (three stations) for the past five years.

3.5.3 Water Use

Vernon Project

In its description of Vermont Yankee Nuclear Power Station's (VY) use of Vernon impoundment water, TransCanada states that the cooling water is returned to the reservoir at a slightly warmer temperature. In fact, it has been reported that discharge temperatures from VY are as high as 100°F (Normandeau 2003), which could be substantially warmer than ambient river water, depending on the season.

3.5.5 Water Quality Standards

All Projects

All three TransCanada projects lie within two state boundaries: Vermont and New Hampshire. Both states classify the Connecticut River in the vicinity of the projects as Class B, but Vermont designates it as coldwater fish habitat, while New Hampshire does not, and the criteria to meet Class B standards differs between the states.

3.5.6 Existing Water Quality Data

All Projects

The PADs provide a summary of existing water quality data. While a number of monitoring efforts have taken place and include sample sites within the project boundary, none of those studies were designed to comprehensively investigate whether all relevant project areas currently meet Class B standards. The monitoring effort conducted by the New Hampshire Department of Environmental Services (NH DES) for the Connecticut River Joint Commission (CRJC) occurred in 2004, and it is unclear how often measurements were taken; the University of Massachusetts Water Resources Research Center's bacterial monitoring that took place in 2008 and 2009 only gathered data from the Wilder Project area; and the U.S. Geological Survey's long-term water quality monitoring station located immediately upstream of the Vernon Project area stopped taking samples in 2007, only collected information roughly once per month, and sampled dissolved oxygen even less frequently.

The PADs contain information on water quality monitoring within the project areas that was completed by TransCanada between June 20, 2012 and September 11, 2012.

Vernon Project

Continuous water quality data were collected in the tailrace and immediately upstream of the dam. Additionally, weekly water column profiles were collected at three locations within the impoundment. Results indicated that water temperature reached critical threshold levels for salmonids. Summary results presented in the PAD indicate that, in general, temperature and pH increased from upstream to downstream, while dissolved oxygen decreased, reflecting the impacts of the impoundment on increased travel time in the river.

Bellows Falls Project

Continuous water quality data were collected in the tailrace, bypass reach, and immediately upstream of the dam. Additionally, weekly water column profiles were collected at three locations within the impoundment. The data indicated that Vermont and New Hampshire water quality standards for dissolved oxygen were not met in the bypass reach and in the impoundment. Furthermore, pH readings collected in water profile measurements indicated that in two different locations during two separate events, the impoundment did not meet Vermont and New Hampshire water quality standards. Summary results presented in the PAD indicate that, in general, temperature and specific conductivity increase from upstream to downstream within the impoundment.

Wilder Project

Continuous water quality data were collected in the tailrace and immediately upstream of the dam. Additionally, weekly water column profiles were collected at three locations within the impoundment. The data indicated that Vermont water quality standards for dissolved oxygen were not met during a seven-day period in August. Summary results presented in the PAD indicate that, in general, temperature and specific conductivity increased from upstream to downstream, while dissolved oxygen decreased, reflecting the impacts of the impoundment.

All Projects

The manner in which the results are presented in the PADs does not allow for an adequate understanding of how water quality is affected by project operations.[1] Further, the results that were presented indicate that water quality standards are not being met during certain periods at some of the projects. TransCanada does not propose to continue the water quality monitoring effort it began last summer. Additional monitoring is needed so that resource agencies can properly evaluate the potential impact of project operations on water quality; therefore, the U.S. Fish and Wildlife Service (Service) herein submits a request for such a study.

Climate Change

The PADs contain no information relative to climate change and how climate change predictions may impact future operation of the hydroelectric plants, nor of how the projects either mitigate for or exacerbate predicted climate change impacts to freshwater ecosystems.

The three mainstem projects have very long impoundments capable of storing large volumes of water. These impoundments effectively have converted large portions of the Connecticut River into a series of in-river "lakes." Because water velocities slow in these impounded sections of river, it allows for increased thermal loading and resultant higher water surface temperatures than in free-flowing sections of river. TransCanada's PADs provide a summary of water quality data collected in 2012. These data indicate that from the upstream end of the Wilder headpond to the Vernon tailrace, water temperature increased approximately 6°C. In addition, the VY discharges heated effluent into the Vernon impoundment, further increasing water temperatures. The most recent climate change prediction models specific to the Northeast forecast warmer air temperatures, more frequent high precipitation events, more heat waves, and an increase in the incidence of short-term droughts (Karl *et al.* 2009). The increase in air temperature will increase thermal loading into the impoundments which will then be discharged downstream of the dams.

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[1] With the exception of trends in water temperature. Monitoring results show that both the mean and median temperature increased by 10°F (6°C) from the uppermost monitoring station in the Wilder impoundment down to the Vernon tailrace station. The cumulative impact of the three long impoundments on water temperature is of concern to the Service, particularly in the context of climate change.

Relative to existing flood management protocols at each station, TransCanada's PADs identify that all three dams utilize stanchion bays (two at Vernon, three at Bellows Falls, and four at Wilder) to release flood flows. When inflows to each dam reach certain levels, the stanchion bays are removed, and cannot be replaced until inflows subside. The depth of these bays and the flows at which they are removed are outlined in Table 1 below.

Table 1. Summary of Pertinent Stanchion Bay Information for the Vernon, Bellows Falls, and Wilder Projects.

Project	Stanchion Height (feet)	Flow Triggering Complete Stanchion Removal
Wilder	17	145,000 cfs
Bellows Falls	13	50,000 cfs
Vernon	10	105,000 cfs

The PADs provide no information on the history of stanchion removal at any of the projects (frequency, duration, timing), nor a discussion of how predicted climate change might alter management of the stanchion bays in the future (with respect to the frequency and seasonality of occurrence). There also is no discussion of potential impacts to headpond resources that occur as a result of stanchion bay removal.

These information gaps need to be filled so resource agencies can assess the relative and cumulative impact of project operations with respect to the Service's management goals and objectives, including those identified in its draft Climate Adaptation Strategy document (Anonymous 2012).

3.6.2 Summary of Existing Fishery Studies

Fish Assemblage

All Projects

In the PADs, TransCanada summarizes stocking data, fish passage data, and fish survey reports. The most relevant fish study related to the Bellows Falls and Wilder project-affected areas is a Connecticut River electrofishing survey conducted in 2008 (Yoder *et al.* 2009). While some sampling was conducted in both project-affected areas during the 2008 survey, this survey was not designed to assess whether project operations are affecting fish assemblages upstream and downstream of the dams. Additionally, both the Bellows Falls and Wilder PADs acknowledged that fish species assemblage data are limited and that the synthesized data may not be a full representation of species occurrence in the project-affected areas.

Although fish data have been collected by VY for many years in the Vernon Dam project-affected area, gear types were generally limited to boat electrofishing, which is not adequate for properly assessing all species present in the project-affected areas.

It is unknown if other species may inhabit or utilize aquatic habitats in the project areas that have not been documented by previous surveys. It follows that without more information on the fish community in the project-affected areas, project impacts on fish species cannot be determined.

A thorough and comprehensive assessment of the fish assemblages present in the project-affected areas of the Vernon, Bellows Falls, and Wilder projects is needed in order to determine whether project operations are impacting the health of the fish community within the project areas. TransCanada has not proposed any studies to address this deficiency; therefore, the Service is submitting a request for such a study.

<u>Headpond Fluctuations</u>

All Projects

All three of TransCanada's projects operate in a peaking mode. In the PADs, TransCanada states that while it is allowed to fluctuate each impoundment anywhere from 3 feet (at Bellows Falls) up to 8 feet (at Vernon), it voluntarily operates the projects over much narrower ranges (1.2 feet at Vernon; 1.8 feet at Bellows Falls; and 2.5 feet at Wilder). However, given that TransCanada is not proposing to formalize those narrower operating ranges in its new license, it still could utilize the full drawdown levels. Regardless, even at the narrower operating bands, there is the potential for the project to dewater littoral areas important to shallow water nesting species.

The PADs contain no site-specific information on littoral spawners residing within the impoundments, or potential impacts of project operations on those species. This information gap needs to be filled so that the agencies can determine appropriate recommendations relative to headpond fluctuation restrictions. The Service herein provides such a request.

In addition to potentially impacting littoral spawners, daily drawdowns also may impact species that move from mainstem habitat into tributaries to spawn or fulfill other life history requirements. The PADs provide no information regarding how far upstream the influence of the impoundments extends into tributaries entering the mainstem. It is possible that when the headponds are at the lower ends of their operating ranges, the mouths of tributaries could become perched, creating a barrier to upstream movement. This issue needs to be investigated so that agencies can use the results to develop recommendations regarding future project operations. The Service herein submits a request to address this issue.

<u>Peaking Releases</u>

Vernon Project

American shad (*Alosa sapidissima*) are known to spawn upstream of the Vernon Dam; however, we are not aware of any studies that have determined actual spawning site locations within the Vernon pool or free-flowing stretch of river below Bellows Falls.

Peaking releases from Bellows Falls produce rapid flow changes, and operations at Vernon Station result in fluctuations of the Vernon pool. Both peaking releases and pond fluctuations affect physical parameters (i.e., water depth and velocity) that may be important for shad spawning success. The Service is not aware of any studies being conducted specifically designed to determine if project operations at Bellows Falls and Vernon affect American shad spawning behavior, habitat use, and egg deposition, therefore we herein submit a study request to address this issue.

All Projects

TransCanada operates all three projects as peaking facilities. During periods of off-peak generation, the projects release required minimum flows equivalent to 0.2 cfm (0.2 multiplied by the drainage area at each respective dam). Below the Wilder Dam, there are 18 miles of free-flowing river, and below the Bellows Falls Dam, there are 6 miles of free-flowing river. The free-flowing reach below Vernon Dam is of undetermined length as noted above. The large and rapid changes in flow releases from hydropower dams are known to cause adverse effects on habitat and biota downstream of the project (Cushman 1985; Blinn *et al.* 1995; Freeman *et al.* 2001). This section of the Connecticut River contains habitat that supports native riverine species, including important spawning and rearing habitat for migratory fish such as American shad and the federally endangered dwarf wedgemussel (*Alasmidonta heterodon*) (DWM).

The Service is not aware of any previously conducted studies that evaluated the adequacy of these minimum flows in protecting aquatic resources in the riverine habitat below each station. Therefore, in order to fill this important information gap, an empirical study is needed to provide information on the relationship between flow and habitat in the Connecticut River downstream of the station tailraces. Results will be used by the Service to determine appropriate flow recommendations. The Service herein submits a study request intended to address this information gap.

<u>Bypass Reach</u>

Bellows Falls Project

The Bellows Falls Project bypasses a 3,500-foot-long section of the Connecticut River. Presently, this bypass reach only receives flow when inflow exceeds the hydraulic capacity of the Bellow Falls station. According to exceedance curves provided in the PAD, the bypass reach receives flow in the following amount of time, each month:

Month	% Time Flow > 11,000 cfs	Month	% Time Flow >11,000 cfs
Jan.	15	July	10
Feb.	15	August	8
March	50	Sept.	4
April	90	Oct.	20
May	60	Nov.	35
June	20	Dec.	26

No information exists on the adequacy of the existing bypass flow regime to protect water quality and aquatic life. The bypass reach receives flow less than 30 percent of the time on an annual basis. While TransCanada did conduct a preliminary water quality study in the summer of 2012, only a summary of the data is provided in the PAD. It does not indicate where the sonde was located, or the bypass reach conditions during the study period (e.g., what was the flow into the bypass reach during the study? was the sonde located in the only wetted area of the bypass reach?). Further, the PAD provides no detailed description of the physical or biological characteristics of the bypass reach.

The Connecticut River in the project vicinity is dominated by sections that are impounded, backwatered from downstream impoundments, or otherwise deep and slow-flowing. In contrast, the Bellows Falls bypass channel is very irregular and diverse, consisting of both coarse substrate of various sizes and in the more downstream segment, jagged, irregular ledge. Given an adequate flow regime, the bypass could provide habitat types that are now rare and therefore of great importance.

An empirical study is needed to provide the Service information on the relationship between flow and habitat in the bypass reach, and in determining appropriate flows in the bypass reach. The Service herein submits a request to address this issue.

The bypass reach at Bellows Falls contains a small dam that was constructed to prevent upstream migrant Atlantic salmon (*Salmo salar*) from becoming trapped and isolated in the bypass reach after being attracted to periodic spill flows. In the PAD, TransCanada does not propose any changes with respect to the barrier dam. However, now that the Atlantic salmon restoration program is in the process of modifying management activities, the need for the barrier dam should be re-evaluated.

<u>Anadromous Fish Studies</u>

Vernon Project

TransCanada provides a summary of a number of studies that have been conducted over the years to evaluate the effectiveness of the downstream bypass facilities at the project. Passage efficiency and turbine survival have been studied for Atlantic salmon smolts before and after turbines 5-8 were replaced. Both turbine survival and passage efficiency were conducted for juvenile shad prior to turbine replacement; the passage efficiency testing was deemed ineffective, but the turbine survival was estimated at 95 percent. No bypass effectiveness or turbine survival studies have been conducted for adult shad, and no such studies have been done for adults or juveniles since the turbines were replaced. These data gaps need to be filled so that agencies can determine the overall through-project survival of post-spawned adult and juvenile shad. The Service herein submits a request to address these issues.

No directed studies have been conducted to evaluate the effectiveness of the upstream fish ladder at the Vernon Project. However, Table 3.6-1 provides passage data at Vernon from 1981 up to 2012, including the ratio of shad passed at Vernon Dam relative to the number passed at the Turners Falls gatehouse. Based on those data, the ratio has ranged from 0 percent to over 100 percent (likely due to undercounting at the Turners Falls Project gatehouse fishway counting facility), with a mean of 41 percent over all years. While this overall passage ratio falls within the goal of 40 percent to 60 percent identified in the Connecticut River Atlantic Salmon Commission Strategic Plan, there have been a number of years when passage fell far short of the stated goal (e.g., 2004 through 2011). In addition, while the internal efficiency of the ladder may be sufficient (when the ladder is being maintained and operated properly), no information exists on potential delays experienced at the ladder entrance. Any delays due to Vernon project operations and/or exposure to VY's thermal discharge could impact spawning success.

Additional information on pre-spawned adult shad movement up to and through the Vernon Project area is needed in order to determine if project operations are impacting shad passage and spawning success. The Service herein submits a request to address this issue.

<u>Resident Fish Passage</u>

All Projects

The three projects currently have upstream fishways primarily designed for passage of Atlantic salmon, and at Vernon, also designed for passage of American shad and blueback herring (*Alosa aestivalis*). The operation of the fishways has been limited to a limited spring period during the anadromous fish passage. Riverine fish and American eel (*Anguilla rostrata*) have used the existing fishways, but there are limited data on counts and not all existing data have been reviewed. In addition, the seasonal operation of the fishways has been limited, whereas riverine species are expected to move both prior to and after the spring anadromous fish upstream passage period. The Service hereby submits a study request to review existing passage data for fish other than anadromous species, and to evaluate the passage of fish throughout the spring, summer and fall periods to assess the appropriate operation period for fishways for riverine species.

3.6.4 Diadromous Species Descriptions

American Eel

All Projects

TransCanada provides a description of the life history of the American eel, as well as the status of its presence within the project areas; according to the PAD, eel have been documented upstream and downstream of the Vernon Project and upstream of the Bellows Falls Project.

The Service is aware that both the New Hampshire Fish and Game Department (NHFGD) and the Vermont Fish and Wildlife Department (VFWD) have observed eels upstream of Wilder Dam (Lael Will, VFWD, personal communication; Gabe Gries, NHFGD, personal communication). While this information indicates that some eels are passing all three dams (Vernon, Bellows Falls, and Wilder), it remains unknown how many eels may be rearing in the mainstem habitat upstream of the dams or in tributaries and lakes and ponds that feed into the mainstem river.

No targeted eel surveys have been conducted to determine the abundance and distribution of American eels in riverine and lacustrine habitat upstream of the three projects. This information gap needs to be filled so resource agencies can properly evaluate the need for, and timing of, downstream passage and protection measures for outmigrating silver phase eels. The Service herein submits a request to address this issue.

Eel Passage

All Projects-Upstream

The PADs contain no information relative to areas where eels seeking to move upstream concentrate downstream of the three dams, or annual numbers of eels attempting to ascend past the dams. While eels have been known to ascend the Vernon and Bellows Falls fish ladders, the efficiency for these structures to pass eels is unknown. In addition, the ladders are only operated during the American shad and salmon passage season at Vernon (April 15 through July 15) and during the salmon passage season at Bellows Falls and Wilder (from May 15 through July 15). While there also is a fall passage season for salmon, typically the ladders are operated during the fall only if there is evidence that there is a salmon immediately below the dam.

Eels are currently able to pass Vernon, Bellows Falls, and Wilder dams (as evidenced by documented presence of eels upstream), but the total number of eels attempting to pass all three dams and the proportion successfully passing each project is unknown (but suspected to be low). The downstream Holyoke Project has operated upstream eel passage facilities since 2004. Last year, these facilities passed over 40,000 juvenile eels. While the next dam upstream (Turners Falls Project, FERC No. 1889) has no dedicated upstream eel passage facilities, eels have been known to ascend the Cabot Station fish ladder (A. Haro, U.S. Geological Survey, personal communication). Although there is rearing habitat in between the Turners Falls and Vernon dams, some eels will attempt to continue upstream, and passage needs to be provided so these fish can access historical habitat.

The Service needs to understand the numbers and locations of juvenile eels downstream of each dam in order to determine the best locations to site upstream eel passage facilities and assess whether operating the existing anadromous ladders would be an effective mechanism to move juvenile eels upstream past the projects. The Service herein submits a study request to address this issue.

All Projects-Downstream

TransCanada operates downstream fish passage facilities at all three projects. The downstream bypasses were designed to guide and pass Atlantic salmon smolts, and studies to determine the effectiveness of the facilities for Atlantic salmon have been conducted. In addition, as mentioned above, the Vernon Project has assessed its downstream passage facilities for American shad (although those studies were inconclusive). Turbine survival studies also have been undertaken at all three projects, both for Atlantic salmon and American shad (although the turbine survival study for shad at Vernon is outdated due to unit replacement). To date, no studies have been undertaken to evaluate the effectiveness of the existing downstream bypasses or turbine survival for silver phase eels.

The Service believes that studies need to be conducted to fully understand how silver phase eels move through the project areas. In addition, turbine and gate discharge mortality studies are needed for eels and should be used in conjunction with the results of the passage routing studies to calculate total through-project survival rates. The Service herein provides a study request in order to address this information need.

Federal Listing Status

All Projects

It should be noted that within the past seven years, the Service has received two petitions to list the American eel under the Endangered Species Act (ESA). The first petition was received on November 18, 2004. On July 6, 2005, the Service issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability (CESAR). On September 29, 2011, the Service issued a substantial 90-day finding and initiated a 12-month status review. The Service is still accepting new American eel information for the ongoing status review. The Service also is currently in settlement negotiations with CESAR on their legal complaint that the Service failed to complete the 12-month finding within the statutory timeframe. It is likely that the Service's 12-month finding on the latest petition will be made prior to any new licenses being issued for the projects. If listed, consultation with the Service will need to be initiated by the Commission as required under section 7 of the ESA.

Sea Lamprey

In its overview of the life history of the sea lamprey (*Petromyzon marinus*), TransCanada fails to mention that during their spawning migrations, adult lamprey are not parasitic because they are not feeding. Given the lamprey's status in the Lake Champlain basin as an invasive pest, it is very important to note the differences between landlocked populations of sea lamprey and those where there is access between the marine and freshwater environment. In the Connecticut River the lamprey is not considered a nuisance, but in fact is a beneficial component of the ecosystem.

As noted in the PADs, sea lamprey have been documented upstream and downstream of the Vernon and Bellows Falls projects and in 2008, a lamprey was counted passing the Wilder fish ladder. Lamprey are known to spawn in the Connecticut River main stem at least as far upstream as Wilder Dam, as well as in tributary waters including the West, Williams, Black and White rivers (Kart *et al.* 2005).

To date, no studies have been conducted that aim to identify spawning habitat and spawning activity of sea lamprey within the Wilder, Bellows Falls, and Vernon project areas or to determine whether project operations are affecting these activities. The Service herein provides a study request in order to address this information need.

3.6.5 Resident Species Descriptions

Tessellated Darter

All Projects

In the PADs for the Wilder, Bellows Falls, and Vernon projects, the Applicant acknowledges that the tessellated darter (*Etheostoma olmstedi*) is one of the confirmed hosts of the DWM. It also identifies the occurrence of the tessellated darter both upstream and downstream of each project. However, information on the impact project operations may have on tessellated darter populations is lacking. Of the known host species for the DWM (Atlantic salmon and slimy sculpin [*Cottus cognatus*] being the other two), the tessellated darter is the only species likely to inhabit the mainstem Connecticut River in the vicinity of the projects; therefore, maintaining healthy, sustainable darter populations is extremely important to the long-term viability of the DWM.

Detailed information on the population dynamics of darter populations within the project-affected areas is needed in order for the agencies to determine if project operations are affecting the tessellated darter. A cumulative effects analysis should be conducted, where appropriate. For example, the Vernon PAD summarizes electrofishing, impingement and entrainment data collected by VY for the period 1991 to 2011. Those data suggest that the tessellated darter is not a large component of the fish assemblage in the Vernon pool. However, TransCanada did not mention that VY undertook a more rigorous entrainment study in 2005 than the annual monitoring effort, sampling from April through September (Normandeau 2011). Results revealed that while only six tessellated darter were seined from Vernon pool during 2005, over three million larvae were entrained at the VY intake.

The Service herein provides a study request in order to address this information need.

3.6.7 Mussels and Macroinvertebrates

Dwarf Wedgemussel

All Projects

In the PADs, TransCanada states that it commissioned BioDrawversity and the Louis Berger Group to conduct a mussel survey in 2011. Areas surveyed included a number of sites extending the length of each impoundment and each tailwater (within one mile below each dam). At Vernon, six mussel species were found in the headpond and four species were found in the tailwater (no DWM were found). At Bellows Falls, seven mussel species (including DWM) were found in the headpond and five species were surveyed in the tailwater. At Wilder, five mussel species (including DWM) were found in the headpond and three species were surveyed in the tailwater.

The 2011 survey did not include free-flowing stretches of river between the projects (beyond the 1-mile tailwater reach). At Wilder, there are 17 miles of free-flowing river that are affected by peaking releases at Wilder. Similarly, below the Bellows Falls Dam, there are 6 miles of free-flowing river affected by peaking operations at Bellows Falls. A better understanding of the distribution and abundance of the DWM in these stretches of the river is required.

In addition, quantitative information regarding population size, density, and age class structure of the mussel communities known to occur within project-affected areas is needed. Further, effects of project operations (headpond fluctuations and peaking releases) on various aspects of DWM biology, including lure display, shell position (open/closed), siphoning rate, and vertical migration, as well as habitat persistence, need to be assessed. The Service herein provides a study request in order to address these information needs. If the results of that study indicate that river flows and water levels associated with the relicensing may affect the DWM or its habitat, further consultation with this office under the Endangered Species Act is recommended.

3.7.3 Plant and Animal Species

Invasive Species

All Projects

In the PADs, TransCanada notes that the Invasive Plant Atlas of New England (IPANE) lists a number of invasive species as occurring in the general vicinity of the projects. Under the Project Effects section of the PADs (section 3.7.4), TransCanada acknowledges that the disturbance resulting from daily project operations creates opportunities for invasive plant species to colonize and dominate the shorelines of the projects. This is an impact that needs to be quantified and addressed as part of the relicensing process. Below we discuss invasive species in more detail.

TransCanada should be aware that in the Connecticut River watershed, six Cooperative Invasive Species Management Area (CISMA) partnerships are working on invasive species projects, including public outreach, inventory and on-the-ground invasive plant control. In addition, a full Connecticut River watershed-wide initiative networks these CISMAs, including state and regional partners, to prioritize invasive plant control actions that plan and implement early detection and rapid response to new invaders to the watershed.

3.8.2 Habitats

<u>Wetlands</u>

All Projects

TransCanada utilized National Wetland Inventory (NWI) maps to determine that wetland habitats cover 109 acres in the vicinity of the Wilder Project, 490 acres of the Bellows Falls Project area, and 123 acres within the Vernon Project area. In addition to NWI maps, TransCanada conducted a shoreline survey in 2011 that identified sites where erosion was occurring, as well as verifying wetlands within the project areas. While the PADs contain general descriptions of different wetland types and provide species typically associated with each type of wetland, it does not appear that TransCanada collected site-specific species information as part of its shoreline survey.

TransCanada acknowledges that the project-induced daily water level fluctuations have resulted in a zone of sparse vegetation along most shorelines of the impoundments and that wetland and littoral resources in the fluctuation zones are limited by the frequent wetting and drying.

Site-specific baseline information on wildlife and botanical resources within each project area is needed in order for the agencies to determine if project operations may be impacting wetland, riparian or littoral species and their habitats (including invasive species). The Service herein provides a study request in order to address this information need.

3.9.2 RTE [Rare Threatened and Endangered] Species in the RTE Project Area

<u>Bellows Falls Project</u>

Table 3.9-1 is missing the federally endangered northeastern bulrush plant (*Scirpus ancistrochaetus*).

3.9.4 Biological Opinions, Status Reports, and Recovery Plans

Bald Eagle

All Projects

The bald eagle (*Haliaeetus leucocephalus*) breeds and overwinters in all three project areas. Known roosting and nesting sites represent important habitat and, to the extent possible, should be protected. More detailed information regarding the locations of active and/or historical roosting and nesting sites is needed, including identification of land use and ownership on those parcels containing roosting and/or nesting sites. These data should be taken into consideration in the development of any shoreline management plan for the projects, including acquisition of those lands outright or establishing conservation easements for their long-term protection and conservation to benefit bald eagles. The Service has included eagle habitat assessment in the study request addressing wetlands and riparian vegetation.

3.10.6 Specially Designated Lands

Silvio O. Conte National Wildlife Refuge

All Projects

We offer the following corrections to acreages given in the PADs: the Conte Refuge now comprises 35,658 acres, and the Nulhegan Basin Division in Vermont's Northeast Kingdom accounts for 26,526 acres.

In addition, TransCanada should be aware that a Cooperative Conservation Plan (CCP) for the Conte Refuge is scheduled to be completed this calendar year. One of the outputs of the CCP will be identification of additional land protection priorities.

4.0 Preliminary Issues and Studies List

All Projects-Proposed Studies

TransCanada is not proposing to conduct any additional studies beyond those already conducted or under development (i.e., shoreline survey, mussel survey, water quality monitoring, federally endangered Jesup's milk vetch [*Astragalus robbinsii* var. jesupi] habitat stage-flow rating curve development, Phase 1A historic and archaeological reconnaissance surveys, river operations optimization/simulation model, and RTE survey).

Regarding the river operations optimization/simulation model, TransCanada proposes to develop a model that would simulate existing operations of the three projects as well as assess alternative operations. While TransCanada would use the model to understand how any changes would impact generation at the stations, the Service supports this study because it will allow the agencies to understand what, if any, limitations there may be to changing project operations to benefit natural resources within and beyond the project areas. The Service herein submits a request for such a study request.

All Projects-PME Measures

TransCanada proposes no PME measures other than to continue the current operational constraints (reservoir operations, high water procedures, and minimum flow releases) and operate the fish passage facilities. TransCanada states that any PME measures for RTE species will be based on the results of the RTE survey.

5.3 Comprehensive Waterway and Resource Management Plans

All Projects

In the Wilder PAD, TransCanada identifies 19 federal plans for New Hampshire and 15 for Vermont recognized by the Commission as Comprehensive Waterway Development Plans. For Bellows Falls, 20 plans are identified for New Hampshire and 12 for Vermont. For Vernon, 19 plans are identified for New Hampshire and 12 for Vermont. In addition to those plans, the Service hereby submits the following plan to the Commission for consideration in determining whether it qualifies as a comprehensive plan pursuant to Section 10(a)(2)(A) of the Federal Power Act (Attachment A):

Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

If the Commission determines that the plan identified above does not qualify as a comprehensive plan, we request that it be considered as a relevant resource management plan.

ADDITIONAL INFORMATION

The following information is needed:

1. the dimensions of the trashracks (wetted area) at each project. This information is needed so that the agencies can calculate the approach velocities;
2. a more thorough description of how project operations are monitored and recorded;
3. hourly data (water surface elevations, dam discharge, generation, from all three projects in spreadsheet format for the past five years; and
4. verification of the extent of the backwatering from the Turners Falls Project and the length of lotic habitat between Vernon Dam and the upper extent of the Turners Falls headpond.

RECOMMENDED STUDIES

The Applicant already has undertaken a shoreline survey, a mussel survey, a water quality monitoring effort, development of a Jesup's milk vetch habitat stage-flow rating curve, Phase 1A historic and archaeological reconnaissance surveys, development of a river operations optimization/simulation model, and RTE surveys. TransCanada proposes no additional studies. Enclosed please find our formal study requests (Attachment B), in the format required pursuant to 18 CFR §4.38(b)(5).

SCOPING DOCUMENT 1

3.6.3 Project Decommissioning

The Commission proposes to eliminate this alternative from detailed study in the environmental analysis, because no party has suggested project decommissioning would be appropriate in this case. The Commission asserts that there would be significant costs involved with decommissioning the projects, including lost energy production.

We recommend that the Commission include project decommissioning in the environmental analysis. No party has suggested this alternative because, up to this point in the Integrated Licensing Process, there has been no formal opportunity to provide such a recommendation. Further, the Commission has supplied no supporting information to justify the contention of significant decommissioning costs; and given the substantial increase in proposed renewable energy projects, it is possible that there may be no net loss of energy production when viewed on a regional basis.

4.1.2 Geographic Scope

The Service recommends that the geographic scope of the Commission's environmental analysis of the impacts to cumulatively effected fishery, water quantity and water quality resources extend from the upstream extent of the Wilder Project impoundment, downstream to Long Island Sound. For terrestrial resource issues, the geographic scope should be from the upstream extent of the Wilder impoundment to the upstream extent of the Holyoke headpond. For threatened and endangered species, the geographic scope should be from the upper extent of the Wilder impoundment to the Holyoke Dam.

4.3.3 Aquatic Resources

Effects of project facilities and operations on fish migration should be analyzed cumulatively as well as for individual projects.

Effects of entrainment should not be limited to fish populations, but should include impacts to food web interactions and overall ecosystem productivity.

Thank you for this opportunity to comment. If you have any questions regarding these comments, please contact John Warner of this office at (603) 223-2541.

Sincerely yours,

Thomas R. Chapman
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Attachments

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ATTACHMENT A

Comprehensive Waterway Development Plans

Atlantic States Marine Fisheries Commission

ADDENDUM II TO THE FISHERY MANAGEMENT PLAN FOR AMERICAN EEL

ASMFC Vision Statement:
Healthy, self-sustaining populations for all Atlantic coast fish species or successful restoration well in progress by the year 2015.

Approved October 23, 2008

INTRODUCTION

The Atlantic States Marine Fisheries Commission's American Eel Management Board initiated the development of Addendum II in January 2007 to propose measures that would facilitate escapement of silver eels during or just prior to their spawning migration as a means to improve American eel recruitment and abundance. Although the available data for American eel in the U.S. have not been sufficient to perform a reliable quantitative assessment of the population size or fishing mortality rates (ASMFC 2001, 2006), there has been evidence that the stock has declined and is at or near low levels (ASMFC 2000, 2001, 2006; USFWS 2007). The Management Board asked the Technical Committee (TC) and Advisory Panel (AP) to consider closed seasons, gear restrictions, size limits or a combination of these measures to reduce the harvest of emigrating eels. The public comment draft of Addendum II proposed these management measures, as well as recommendations for increased protection of American eels during their upstream and downstream migration.

This Addendum recommends stronger regulatory language to improve upstream and downstream passage of American eel to state and federal regulatory agencies. As such, there is no implementation schedule and there are no new compliance requirements. Member states are still required to submit annual compliance reports by September 1. This Addendum does not alter any other provisions from the Interstate Fishery Management Plan (FMP) and makes no changes to Addendum I to the FMP.

Background

The American eel occupies fresh, brackish, and coastal waters along the Atlantic from the southern tip of Greenland to northeastern South America. The species is catadromous, spending the majority of life in freshwater, but migrating to the Sargasso Sea to spawn. Newly hatched eels drift on oceans currents, eventually entering nearshore areas where they migrate up-river. Therefore, a comprehensive eel management plan and comprehensive set of regulations must consider the various unique life stages and the diverse habitats used, in addition to society's interest and use of this resource.

American eel (*Anguilla rostrata*) occupy a significant and unique niche in the Atlantic coastal reaches and its tributaries. Historically, American eel were very abundant in East Coast streams, comprising more than 25 percent of the total fish biomass. Eel abundance declined from historic levels but remained relatively stable until the 1970s. More recently, fishermen, resource managers, and scientists postulated a further decline in abundance based on harvest information and limited assessment data. This resulted in the development of the Atlantic States Marine Fisheries Commission FMP for American Eel. The goals of the FMP are:

1. Protect and enhance the abundance of American eel in inland and territorial waters of the Atlantic States and jurisdictions and contribute to the viability of the American eel spawning population; and
2. Provide for sustainable commercial, subsistence, and recreational fisheries by preventing overharvest of any eel life stage.

In support of these goals, the following objectives were included in the FMP:

- Improve knowledge of eel utilization at all life stages through mandatory reporting of harvest and effort by commercial fishers and dealers, and enhanced recreational fisheries monitoring.
- Increase understanding of factors affecting eel population dynamics and life history through increased research and monitoring.
- Protect and enhance American eel abundance in all watersheds where eel now occur.
- Where practical, restore American eel to those waters where they had historical abundance but may now be absent by providing access to inland waters for glass eel, elvers, and yellow eel and adequate escapement to the ocean for pre-spawning adult eel.
- Investigate the abundance level of eel at the various life stages, necessary to provide adequate forage for natural predators and support ecosystem health and food chain structure.

Status of the Stock

Current stock status (i.e., overfished or not overfished) for American eel is poorly understood due to limited and non-uniform stock assessment efforts and protocols across the species' range. No range-wide estimate of abundance exists and reliable indices of abundance of this species are scarce. Information on demographic structure is lacking and difficult to determine because the American eel is a single population (termed *panmixia*) with individuals randomly spread over an extremely large and diverse geographic range, with growth rates and sex ratios environmentally dependent. At present, limited data (fishery-dependent and independent) from indirect measurements (harvest by various gear types and locations) and localized direct stock assessment information are collected.

In 2003, declarations from the International Eel Symposium (AFS 2003, Quebec City, Quebec, Canada) and the Great Lakes Fishery Commission (GLFC) highlighted concerns regarding the health of American eel stock. Canada has recently applied the "Special Concern" designation to American eel. Available data attributes the population drop to decreasing recruitment combined with localized declines in abundance. This information is cause for concern and represents an opportunity for cooperation with other entities such as the GLFC to preserve the American eel stock.

The most recent peer reviewed stock assessment was presented to the Commission's American Eel Management Board in February 2006. The stock assessment did not meet some of the terms of reference according to the Terms of Reference and Advisory Report to the American Eel Stock Assessment Peer Review (ASMFC 2006). In May 2006, the Board tasked the American Eel Stock Assessment Subcommittee (SASC) with following up on specific recommendations in the peer review report to improve the 2005 stock assessment. The SASC follow-up to the Terms of Reference and Advisory Report to the American Eel Stock Assessment Peer Review was presented to the Board in October 2006. This report was inconclusive regarding the status of the stock. In their follow-up report, the SASC created a coastwide index for American eel using yellow eel indices that are monitored along the Atlantic Coast, both in the United States and Canada, and combing them with General Linear

Modeling (GLM). The SASC's report included a suggestion that the coastwide yellow eel GLM index could be used as a management trigger and would be a means to monitor coastwide, yet act locally.

In reaction to the extreme declines in eel abundance the Saint Lawrence River-Lake Ontario portion of the species' range, the Commission requested in 2004 that the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) conduct a status review of American eel. In February 2007, the USFWS announced the completion of a Status Review for American eel. The report concluded that protecting eel as an endangered or threatened species is not warranted. The USFWS did note that while the species' overall population is not in danger of extinction or likely to become so in the foreseeable future, the eel population has "been extirpated from some portions of its historical freshwater habitat over the last 100 years...[and the species abundance has declined] likely as a result of harvest or turbine mortality, or a combination of factors" (50 CFR Part 17).

Following the 2005 stock assessment, Terms of Reference and Advisory Report to the American Eel Stock Assessment Peer Review, and Stock Assessment Subcommittee's 2006 report, the Board initiated this Addendum to consider management options to halt the current decline in yellow eel abundance.

Status of the Fishery

American eel currently support important commercial fisheries throughout their range. Fisheries are executed in rivers, estuaries, and ocean. Commercial glass eel harvest is legal in Maine and South Carolina, although reported landings are minimal in South Carolina. Yellow and silver eel fisheries exist in all states and jurisdictions with the exception of Pennsylvania and the District of Columbia. South Carolina and Georgia recorded no commercial yellow or silver eel landings in 2007.

Commercial

Commercial landings decreased from a high of 1.8 million pounds in 1985 to a low of 641,000 pounds in 2002. Landings of yellow and silver eel in 2007 totaled 834,500 pounds.[1] New Jersey and Delaware each reported landings over 100,000 pounds of eel and Maryland reported landings over 300,000 pounds in 2007. Combined, these three states accounted for 73% of the coastwide commercial landings. Massachusetts, Pennsylvania, Georgia, Florida, and the District of Columbia were granted *de minimis* status for the 2007 commercial fishing year. D*e minimis* is approved if a member states' commercial landings of yellow and silver eel for the previous year is less than 1% of the coastwide landings for the same year. Additionally, member states must request *de minimis* status.

Recreational

Few recreational anglers directly target eel and most landings are incidental when anglers are fishing for other species. Eel are often purchased by recreational fishermen for use as bait for larger sport fish such as striped bass, and some recreational fishermen may catch their own eel to utilize as bait. The NMFS Marine Recreational Fisheries Statistics Survey (MRFSS)

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[1] Harvest data for 2007 comes from the 2008 State Compliance Reports. The landings are preliminary and some are incomplete.

shows a declining trend in the catch of eel during the latter part of the 1990s. According to MRFSS[2], 2007 recreational total catch was 140,372 fish, which represents a 63% increase in number of fish from 2006 (86,024 fish). About 59% of the eel caught were released alive by the anglers. MRFSS 2007 total recreational harvest was 57,986 fish.

For current commercial and recreational regulations for American eel by state, please see Appendix I.

STATEMENT OF THE PROBLEM

While the status of the American eel stock is uncertain, the latest stock assessment information indicates that the abundance of yellow eel (a juvenile life stage) has declined in the last two decades and the stock is at or near low levels. Further, relative abundance is likely to continue to decline unless mortality decreases and recruitment increases. The American Eel Management Board directed the American Eel Plan Development Team (PDT) to develop potential management measures for American eel that would facilitate an increase in the number of adult American eel (also known as silver eel) that are able to move from fresh and estuarine water to the ocean—also known as out-migrate—and spawn. The recommended management measures included gear and size restrictions, seasonal closures, and a recommendation to protect the upstream and downstream migration of American eel.

The Board initiated this Addendum based on a concern for the American eel population and sought public comment on measures that would facilitate escapement of silver eel on their spawning migration with the intent of halting any further declines in juvenile recruitment and eel abundance. The Board chose not to implement any additional restrictions on the fishery at this time and requested that a new stock assessment be initiated to better understand the stock status. The primary objective of this document is to recommend stronger regulatory language to improve upstream and downstream passage of American eel to state and federal regulatory agencies.

PROPOSED MANAGEMENT OPTIONS from the PUBLIC COMMENT DRAFT of ADDENDUM II

Gear restrictions, size limits, and seasonal closures employed individually or in combination can protect out-migrating silver eels by allowing more silver eel to reach the Sargasso Sea and spawn. American eel larvae and glass eel recruit to estuaries and freshwater at random; it is predicted that increased escapement from any part of the species' range has the potential to benefit the species throughout the entire range. While operating under the theory that allowing more silver eel to escape will result in increased juvenile recruitment, the PDT recognizes that several factors can influence the amount of silver eels that are allowed to out-migrate, including:

1. The time duration in which silver eel out-migrate;

[2] MRFSS Data for American Eel are unreliable. 2007 Proportional Standard Error (PSE) values for recreational harvest in Massachusetts, Rhode Island, New Jersey, Delaware, Virginia, and South Carolina are 100, 84.3, 70.2, 100.4, 100 and 100 respectively.

2. The portion of the out-migration period that is covered by the closed season;
3. The maximum size eel that gear can catch;
4. The maximum size eel that harvesters are allowed to possess.

The Board chose to delay action on commercial fishery management measures in order to incorporate the results of the upcoming stock assessment, which will present new and updated information on American eel stock status, including the long-term young-of-the-year index being conducted by the states. In addition, the Board received substantial public comment and advice from its Advisory Panel that further restrictions on American eel harvest would significantly impact fishermen. The states will revisit management measures upon completion of the American eel stock assessment.

RECOMMENDATIONS FOR IMPROVING UPSTREAM AND DOWN STREAM PASSAGE OF AMERICAN EEL

There are multiple factors that influence the American eel population across its range, as well as factors that influence their local abundance. Such factors include barriers to upstream and downstream migration, loss of habitat, and natural oceanographic conditions. On the Atlantic and Gulf coasts, 33,663 dams potentially hinder American eel movement. Of these dams, 1,511 (4.5 percent) are for hydropower (50 CFR Part 17).

Recommendations for Federal Energy Regulatory Commission Relicensing
The Commission recognizes that many factors influence the American eel population, including harvest, barriers to migration, habitat loss, and natural climatic variation. The Commission's authority, through its member states, is limited to controlling commercial and recreational fishing activity; however, to further promote the rebuilding of the American eel population, the Commission strongly encourages member states and jurisdictions, as well as the U.S. Fish and Wildlife Service, to consider and mitigate, if possible, other factors that limit eel survival. Specifically, the Commission requests that member states and jurisdictions request special consideration for American eel in the Federal Energy Regulatory Commission relicensing process. This consideration should include, but not be limited to, improving upstream passage and downstream passage, and collecting data on both means of passage.

Recommendations for Improving American Eel Passage at Non-Federally Licensed Dams
Of the 33,663 dams located on the Atlantic and Gulf Coasts that potentially hinder American eel movement, 95% are not licensed by the federal government. Therefore, the states should strive to remove these obstructions where feasible. If removal is not feasible, then upstream and downstream passage should be improved to provide access to inland waters for glass eel, elvers, and yellow eel and adequate escapement to the ocean for pre-spawning adult eel consistent with the goal of the FMP.

APPENDIX I

Table A1. Commercial Regulations by State*

State	Size Limit	License/Permit	Other
ME		· Harvester and dealer license · Dealer reporting	· Seasonal closures · Gear restrictions
NH	6"	· Commercial saltwater license · Coastal harvest permit · Monthly trip level catch & effort reporting of harvest	· 50/day for bait · Gear restrictions in freshwater
MA	6"	· Commercial permit with annual catch report requirement · Registration and reporting for all eel buyers	· Nets, pots, spears, and angling only · Mesh restrictions · Coastal towns may have additional requirements
RI	6"	· Commercial fishing license required for the sale of American eel · Quarterly reporting	
CT	6"	· Commercial license with dealer reporting	· Gear restrictions
NY	6"	· Commercial harvester and dealer license and harvester reporting	· Gear restrictions
NJ	6"	· License required · Monthly reporting for eel pot license	· Gear restrictions
PA		· No commercial fishery	
DE	6"	· License required · Monthly reporting with catch and effort	· Commercial fishing in tidal waters only
MD	6"	· Licensed required with monthly reporting.	· Prohibited in non-tidal waters · Gear restrictions · Commercial crabbers 50 eel pots/day max no harvest limit
DC		· No commercial fishery	
PRFC	6"	· Eel license · Harvester weekly reporting w/daily effort	· Gear restrictions
VA	6"	· License with two-year delayed entry system · Mandatory monthly reporting (at trip level)	· Mesh size restrictions on eel pots
NC	6"	· Standard Commercial Fishing License for all commercial fishing	· Mesh size restrictions on eel pots · Bait limit of 50 eels/day
SC		· Permits by gear and area fished · Mandatory monthly reporting · License for all commercial fishing and sale	· Various gear restrictions
GA	6"	· Personal commercial fishing license and commercial fishing boat license · Harvester/dealer reporting required	· Gear restrictions on traps and pots
FL		· Commercial fishing license · Mandatory permit for all commercial eel harvesters · Mandatory trip and monthly sales summary reporting for permittees	· Gear restrictions

* For specifics on licenses, gear restrictions, and area restrictions, please contact the individual state.

Table A2. Recreational Regulations by State*

State	Size Limit	Possession Limit	Other
ME	6"	50 eels/person/day	· Gear restrictions · License requirement and seasonal closures (inland waters only)
NH	6"	50 eels/person/day	· Coastal harvest permit needed if taking eels other than by angling · Gear restrictions in freshwater.
MA	6"	50 eels/person/day	· Nets, pots, spears, and angling only · Mesh restrictions · Coastal towns may have additional requirements
RI	6"	50 eels/person/day	
CT	6"	50 eels/person/day	
NY	6”	50 eels/person/day	· Additional length restrictions in specific inland waters
NJ	6"	50 eels/person/day	
PA	6"	50 eels/person/day	· Gear restrictions
DE	6"	50 eels/person/day	· Two pot limit/person
MD	6"	No possession limit in tidal areas (hook & line); 25/person/day w/10 eel pot max for rec. crabber in tidal; 25/person/day in non-tidal	· Gear restrictions
DC	6"	10 eels/person/day	· Five trap limit
PRFC	6"	50 eels/person/day	· Recreational license
VA	6"	50 eels/person/day	· Recreational license, no reporting · Recreational commercial gear license, annual report required · Two eel pot limit (both licenses) · Mandatory annual catch report for eel pot license · Mesh size restrictions on eel pots
NC	6"	50 eels/person/day	· Gear restrictions · Noncommercial special device license, allowed two eel pots under Recreational Commercial Gear license
SC	None	None	· Gear restrictions
GA	None	None	
FL	None	None	· Mesh size and funnel opening restrictions on eel pots

* For specifics on licenses, gear restrictions, and area restrictions, please contact the individual state.

ATTACHMENT B

Study Requests

TransCanada Study Request #1

Model River Flows and Water Levels Upstream and Downstream from the Wilder, Bellows Falls, and Vernon Stations and Integrate Project Modeling with Downstream Project Operations

(Bellows Falls, P-1855; Wilder, P-1892; Vernon, P-1904)

Goals and Objectives

The goal of this study is to develop river flow models that permit the evaluation of the hydrologic changes to the Connecticut River caused by the physical presence and operation of the Wilder, Bellows Falls, and Vernon hydroelectric projects and the interrelationships between the operation of all five hydroelectric projects up for relicensing and river inflows. Specific objectives of this study include:

1. Conduct quantitative hydrologic modeling of the hydrologic influences and interactions that exist between the water surface elevations of the Wilder, Bellows Falls, and Vernon project impoundments and discharges from the Wilder, Bellows Falls, and Vernon projects and the downstream hydroelectric projects, including:
    a. inflows into the Wilder, Bellows Falls, and Vernon impoundments from the Fifteen Mile Falls Project, FERC No. 2007, and other sources;
    b. existing and potential discharges from the Wilder, Bellows Falls, and Vernon project generating facilities and spill flows, including existing and potential minimum flow and other operational requirements;
    c. existing and potential water level fluctuation restrictions (maximum and minimum pond levels) of the Wilder, Bellows Falls, and Vernon impoundments, and consequent changes in downstream project discharges; and
    d. incorporation of the potential effects of climate-altered flows on project operations over the course of the license.

2. Assess how existing and potential operations of the Wilder, Bellows Falls, and Vernon projects affect the operations of the Northfield Mountain Pumped Storage and Turners Falls projects, including:
    a. how Wilder, Bellows Falls, and Vernon flow fluctuations affect pool levels of the Turners Falls impoundment; and
    b. how operations of the Wilder, Bellows Falls, and Vernon projects affect Turners Falls discharges.

Resource Management Goals

The U.S. Fish and Wildlife Service (Service) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the projects.

Specific to aquatic resources, the Service's goals are:

1. Protect, enhance, or restore diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Provide an instream flow regime that meets the life history requirements of diadromous fish and resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the areas impacted by project operations.
3. Minimize current and potential negative project operation effects on water quality and aquatic habitat.
4. Minimize the current negative effect of project operations on shortnose sturgeon spawning and rearing within the Montague spawning area (i.e., Rock Dam and Cabot Station spawning sites and associated early life stage rearing areas) at the Turners Falls Project.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

Public Interest

The requestor is a resource agency.

Existing Information

Available information in the PADs does not indicate how project operations have altered the hydrology downstream from each of these facilities, which may affect resident and migratory fish, macroinvertebrates, rare, threatened and endangered species, aquatic plants and other biota and natural processes in the Connecticut River. It is also unclear how operations at one facility affect the operations at another.

Nexus to Project Operations and Effects

The Wilder, Bellows Falls, and Vernon projects are each currently operated with required minimum flows of 675 cfs, 1,083 cfs, and 1,250 cfs (or inflows if less) for each facility, respectively, though in practice minimum flows are operated as 700 cfs, 1,300 cfs, and 1,600 cfs, respectively. There is presently no required minimum flow for the bypassed reach of the Bellows Falls Project. Each of the projects operates as a daily peaking facility, such that "generation can vary during the course of any day between the required minimum flow and full capacity if higher flows are available" (p. 2-28, p. 2-29, and p. 2-30 in the Wilder, Bellows Falls and Vernon PADs, respectively). Total hydraulic capacity of each facility is 12,700 cfs, 11,010 cfs, and 12,634 cfs, respectively. Regular daily fluctuations on the order of 9,000 cfs or greater are commonly recorded at USGS gages 01144500 (Connecticut River at West Lebanon, New Hampshire, below Wilder Dam) and 01154500 (Connecticut River at North Walpole, New Hampshire, below Bellows Falls Dam). Daily fluctuations in headpond elevation are approximately 2.5' (382' to 384.5' MSL), 1.2' (289.9' to 291.1' MSL), and 1.2' (218.6' to 219.8' MSL) at the Wilder, Bellows Falls, and Vernon impoundments, respectively.

These described changes affect biotic habitat and biota upstream and downstream of each project. Project operations and potential changes to operations to mitigate impacts at each facility are influenced by inflows and operations of upstream projects. Results of river flow analyses will provide necessary information regarding changes that can be made to the Wilder, Bellows Falls, and Vernon project flow releases and/or water level restrictions, how such changes may be constrained by inflows and upstream project operations, and how these changes potentially affect downstream resources. This information will then be used to develop flow-related license requirements and/or other mitigation measures.

Methodology Consistent with Accepted Practice

River hydrology statistics and hourly flow modeling are commonly employed at hydroelectric projects to assess implications of project operations on the river environment.

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

Level of effort and cost of model development are expected to be moderate, as much of the baseline modeling has already been completed, but running of various scenarios through the model(s) will be needed throughout the relicensing process to assess the implications of changes to the operations of each project on other projects and other resources. The modeling exercise will also require coordination and cooperation between TransCanada and the downstream licensee to assure that the model inputs and outputs can be accurately related.

We would anticipate that the expected level of effort and anticipated costs will be comparable to those experienced on similar Federal Energy Regulatory relicensing projects of this size (e.g., Conowingo, FERC No. 405).

TransCanada Study Request #2

Instream Flow Habitat Assessment
Downstream of Wilder, Bellows Falls, and Vernon Dams

(Bellows Falls, P-1855; Wilder, P-1892; Vernon, P-1904)

Goals and Objectives

The goal of this study is to determine an appropriate flow regime that will protect and enhance the aquatic resources below the Wilder, Bellows Falls, and Vernon projects. Specifically, the objective of this study is to conduct an instream flow habitat study to assess the impacts of the range of proposed project discharges on the wetted area and optimal habitat for key species.

The study should include non-steady flow approaches to assess effects of within-day flow fluctuations due to peaking power operations on target fish species and benthic invertebrate communities. Target species will include, but are not limited to American shad, fallfish, white sucker, yellow perch, smallmouth bass, walleye, and dwarf wedgemussel.

Resource Management Goals

The U.S. Fish and Wildlife Service (Service) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the projects.

Specific to aquatic resources, the Service's goals are:

1. Protect, enhance, or restore diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Provide an instream flow regime that meets the life history requirements of resident and migratory fish and wildlife (including invertebrates such as freshwater mussels) throughout the areas impacted by project operations.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

Public Interest

The requestor is a fish and wildlife resource agency.

Existing Information

The distance from the upstream end of the Wilder impoundment downstream to the Vernon Dam is 120 miles. A total of 97 miles (81 percent) of this segment is impounded. The remaining riverine habitat is within the 17 miles downstream of Wilder Dam and the 6 miles downstream of Bellows Falls. At the scoping meetings, FirstLight also indicated that their project assessment may provide evidence that the upstream extent of the Turners Falls impoundment may not reach all the way to Vernon Dam. This would suggest that there may be additional riverine habitat for a presently unknown distance below the Vernon Project.

The Wilder, Bellows Falls, and Vernon projects are each operated as daily peaking facilities. Total hydraulic capacity of each facility is 12,700, 11,010, and 12,634 cfs, respectively. Each of the PADs for these projects indicate that "Generation can vary during the course of any day between the required minimum flow and full capacity if higher flows are available" (p. 2-28, p. 2-29, and p. 2-30 in the Wilder, Bellows Falls and Vernon PADs, respectively). Regular daily fluctuations on the order of 9,000 cfs or greater are commonly recorded at USGS gages 01144500 (Connecticut River at West Lebanon, New Hampshire, below Wilder Dam) and 01154500 (Connecticut River at North Walpole, New Hampshire, below Bellows Falls Dam). Required minimum flows are 675, 1,083, and 1,250 cfs (or inflows if less) for each facility, respectively, though in practice minimum flows are operated as 700, 1,300, and 1,600 cfs, respectively. The PADs for these projects do not indicate how these minimum flow requirements were established or what specific ecological resources they are intended to benefit. The Service is not aware of any previously conducted studies that have evaluated the adequacy of this minimum flow in protecting aquatic resources in the 23+ miles of riverine habitat below these projects, nor project effects of daily hydropeaking on riverine habitat. Therefore, in order to fill this important information gap, an empirical study is needed to provide information on the relationship between flow and habitat in the Connecticut River downstream of the Wilder, Bellows Falls, and Vernon projects. Results will be used by the Service to determine an appropriate flow recommendation.

Nexus to Project Operations and Effects

The Wilder, Bellows Falls, and Vernon projects are currently operated with a minimum flow release that was not based on biological criteria or field study. Further, the projects generate power in a peaking mode resulting in substantial within-day flow fluctuations between the minimum and project capacity. The large and rapid changes in flow releases from peaking hydropower dams are known to cause adverse effects on downstream habitat and biota (Cushman 1985; Blinn *et al.* 1995; Freeman *et al.* 2001). There are at least 23 miles of lotic (flowing) habitat below the projects' discharge that are impacted by peaking operations from these projects. This section of the Connecticut River contains habitat that supports native riverine species, including the federally endangered dwarf wedgemussel, and could include spawning and rearing habitat for migratory fish such as American shad. While the existing licenses of the

Wilder, Bellows Falls, and Vernon projects do require a continuous minimum flow of 675, 1,083, and 1,250 cfs, respectively, we do not believe this flow sufficiently protects the aquatic resources, including endangered species, of these river reaches, especially in the context of the magnitude, frequency, and duration of changes in habitat that likely occur due to hydropeaking operations.

Results of the flow study will be used by the Service to determine an appropriate flow recommendation that will protect and/or enhance the aquatic resources below the Project.

Methodology Consistent with Accepted Practice

Instream flow habitat assessments are commonly employed in developing operational flow regimes that will reduce the impacts or enhance habitat conditions downstream of hydroelectric projects.

The Service requests a flow study be conducted in the following areas: within an area approximately 17 miles between the Wilder Dam and the headwaters of the Bellows Falls pool, within an area approximately 6 miles between the Bellows Falls Dam and the headwaters of the Vernon pool, and within an area approximately 1.5 miles between Vernon Dam and the downstream end of Stebbins Island (or the upstream extent of the Turners Pool as determined by FirstLight, whichever river length is greater).

Given the length of river reach (23+ miles) impacted by project operations, we believe a study methodology that utilizes an IFIM approach is appropriate for this context. Similar protocols have been used and accepted by the Federal Energy Regulatory Commission (Commission) in numerous other licensing proceedings.

The study design should involve collecting wetted perimeter, depth, velocity, and substrate data along transects in the deep, straight-channel areas of the specified river reaches mentioned above. Two-dimensional hydraulic modeling should be conducted in the sections of river with more complex features such as islands, braiding, falls, and shallow-water shoals. The measurements should be taken over a range of flows sufficient to model the full extent of the operational flow regime. This information should then be synthesized to quantify habitat suitability (using mutually agreed upon habitat suitability index [HSI] curves) over a range of flows for target species identified by the fisheries agencies. Data should be collected in such a way that allows a dual-flow analysis and habitat time series or similar approaches that will permit assessment of how quality and location of habitat for target species changes over the range of flows that occur as part of the operational flow regime.

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

Field work for instream flow studies can be reasonably extensive, but will depend on consultation with the Applicant on study methodology and on-site decisions on locations for data collection, and the number of collection locations. Use of laser measurements, GPS, and/or an Acoustic Doppler Current Profiler (ADCP, if available) can improve efficiency and accuracy of field measurements. Post-field work data analysis would result in a moderate cost and effort.

We anticipate that the level of effort and costs will be comparable to those of other Commission relicensing projects of similar size to these projects.

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Cushman, R.M. 1985. Review of ecological effects of rapidly varying flows downstream from hydroelectric facilities. North American Journal of Fisheries Management 5: 330–339.

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TransCanada Study Request #3

Bellows Falls Bypass Flow
(Bellows Falls, P-1855)

Goals and Objectives

The goal of this study is to determine an appropriate bypass flow that will protect and enhance the aquatic resources of the Bellows Falls bypass reach.

The objective of the study will be to evaluate the relationship between flow and habitat suitability in the bypass reach.

Resource Management Goals

The U.S. Fish and Wildlife Service (Service) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the project.

Specific to aquatic resources within the Bellows Falls bypass reach, the Service's goals are:

1. Protect, enhance, or restore diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Provide appropriate flows in the bypass reach that meet the life history requirements of resident fish and wildlife, including freshwater mussels and other benthic invertebrates.
3. Minimize current and potential negative project operation effects on water quality and aquatic habitat.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

Public Interest

The requestor is a natural resource agency.

Existing Information

The Bellows Falls Project bypasses a 3,500-foot-long section of the Connecticut River. Presently, this bypass reach only receives flow when inflow exceeds the hydraulic capacity of the Bellow Falls station. According to exceedance curves provided in the PAD, on a monthly basis, the bypass reach receives flow the following amount of time:

Month	**% Time Flow > 11,000 cfs**	**Month**	**% Time Flow >11,000 cfs**
Jan.	15	July	10
Feb.	15	August	8
March	50	Sept.	4
April	90	Oct.	20
May	60	Nov.	35
June	20	Dec.	26

No information exists on the adequacy of the existing bypass flow regime to protect water quality and aquatic life. The bypass reach receives flow less than 30 percent of the time on an annual basis. While TransCanada did conduct a preliminary water quality study in the summer of 2012 that indicated water quality at the bypass reach sample station was not meeting state water quality standards, only a summary of the data is provided in the PAD. It does not indicate where the sonde was located, nor the bypass reach conditions during the study period (e.g., what was the flow into the bypass reach during the study? was the sonde located in the only wetted area of the bypass reach?). Further, the PAD provides no detailed description of the physical or biological characteristics of the bypass reach.

An empirical study is needed to provide information on the relationship between flow and habitat in the bypass reach for the Service to use in determining appropriate flows in the bypass reach.

Nexus to Project Operations and Effects

The project includes a 3,500-foot-long bypass reach. Absent a mandated discharge at the dam, this habitat would remain dewatered during those times when inflow was within the hydraulic capacity of the units (~70 percent of the time on an annual basis). The existing license does not require any flow through the bypass reach. The current situation does not sufficiently protect the aquatic resources inhabiting or potentially inhabiting the bypass reach.

The Connecticut River in the project vicinity is dominated by sections that are impounded, backwatered from downstream impoundments, or otherwise deep and slow-flowing. In contrast, the Bellows Falls bypass channel is very irregular and diverse, consisting of both coarse substrate of various sizes and in the more downstream segment, jagged, irregular ledge. Given an adequate flow regime, the bypass could provide habitat types that are now rare and therefore of great importance.

Results of the flow study will be used by the Service to determine an appropriate flow recommendation that will protect and/or enhance the aquatic resources in the bypass reach for the duration of any new license issued by the Federal Energy Regulatory Commission (Commission).

Methodology Consistent with Accepted Practice

The Service requests a bypass flow study be conducted at the project. Bypass flow habitat assessments are commonly employed in developing flow release protocols that will reduce impacts or enhance habitat conditions in reaches of river bypassed by hydroelectric projects.

Given the size of the bypass reach (3,500 feet long) and the rareness of the habitat types it contains in this portion of the Connecticut River, we believe a study methodology that utilizes an IFIM approach is appropriate for this site. This same protocol was used during the relicensing of the Housatonic River Project (FERC No. 2576),[1] and has been accepted by the Commission in other licensing proceedings.[2]

Given the unique channel formation habitat modeling using standard PHABSIM one dimensional modeling may not be sufficient to assess the habitat suitability in the bypass reach, but rather two dimensional, 2D modeling may be needed to better characterize flows and velocities in this reach. We recommend that the approach to habitat modeling be determined during the study plan development stage based on consultations between the Applicant and the resource agencies.

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

Field work for flow studies can be reasonably extensive, but will depend on consultation with the Applicant on study methodology and on-site decisions on locations for data collection and the number of collection locations. Post-field work data analysis would result in moderate cost and effort. Field work associated with this study could be done in conjunction with the Instream Flow Study Request. We anticipate that the level of effort and costs will be comparable to those experienced on similar Commission relicensing projects (e.g., the Glendale Project, FERC No. 2801).

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1 Housatonic River Project License Application, Volume 4, Appendix F. Connecticut Light and Power Company, August 1999.

2 Glendale Project (FERC No. 2801) Final Bypass Reach Aquatic Habitat and Instream Flow Study <u>in</u> Glendale Hydroelectric Project Application for Subsequent License (FERC No. 2801), Volume 2, Appendix B, pp. 7-8, October 2007.

TransCanada Study Request #4

Impact of the Operations of the Turners Falls, Northfield Mountain Pumped Storage, Vernon and Bellows Falls Projects on Shad Spawning, Spawning Habitat, and Egg Deposition

(Turners Falls, P-1889; Northfield Mountain, P-2485; Bellows Falls, P-1855; Wilder, P-1892; Vernon, P-1904)

Conduct a field study of spawning by American shad in the Connecticut River mainstem downstream of Turners Falls Dam, in the Turners Falls Dam impoundment, in the Vernon Dam Project area, and downstream of Bellows Falls Dam to determine if project operations (including operations of the Northfield Mountain Pump Storage) (NMPS) negatively impact shad spawning behavior, spawning habitat use, areal extent and quality of those spawning areas, and spawning activity in terms of egg deposition in those areas.

Goals and Objectives

Determine if project operations (under the permitted and proposed operational ranges) affect American shad spawning site use and availability, spawning habitat quantity and quality, and spawning activity in the river reaches downstream from Cabot Station and in the project bypass reach of Turners Falls Dam, in the Turners Falls Dam impoundment, and in relation to NMPS operations, downstream and upstream of the Vernon Dam, and in the project area downstream of Bellows Falls Dam. The following objectives will address this request:

1. determine areas utilized by American shad for spawning by conducting nighttime visual observation of spawning activity, identify and define areas geospatially, and obtain data on physical habitat conditions affected by project operations (e.g., water depth, velocity, discharge, substrate, exposure and inundation of habitats);
2. determine project operation effects on observed spawning activity, under a range of permitted or proposed project operation conditions;
3. quantify effects (e.g., water velocity, depths, inundation, exposure of habitats) of project operation on identified spawning areas for a range of conditions, over the complete period of spawning activity; and
4. quantify spawning activity as measured by nighttime spawning/splash surveys and egg collection in areas of spawning activity, and downstream of these areas, to further determine project operation effects (location and extent of exposure from changing water levels and flows).

If it is determined that the project operations are adversely affecting the spawning activity of American shad and impacting spawning habitat, identify operational regimes that will reduce and minimize impacts to spawning habitat and spawning success. This study will require two years of field data to capture inter-annual variability to river discharge and water temperatures and to allow for evaluation of alternative flow regimes if year one studies determine that the present peaking regime negatively affects spawning.

Resource Management Goals

The Connecticut River Atlantic Salmon Commission (CRASC) developed *A Management Plan for American Shad in the Connecticut River* in 1992. Management objectives in the plan include the following:

1. Achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually.
2. Achieve annual passage of 4 percent to 60 percent of the spawning run (based on a five-year running average) at each successive upstream barrier on the Connecticut River mainstem.

The Atlantic States Marine Fisheries Commission, Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management), approved in 2010, includes the following objective:

Maximize the number of juvenile recruits emigrating from freshwater stock complexes:

1. to mitigate hydrological changes from dams, consider operational changes such as turbine venting, aerating reservoirs upstream of hydroelectric plants, aerating flows downstream, and adjusting instream flows;
2. natural river discharge should be taken into account when instream flow alterations are being made to a river (flow regulation) because river flow plays an important role in the migration of diadromous fish;
3. ensure that decisions on river flow allocation (e.g., irrigation, evaporative loss, out of basin water transport, hydroelectric operations) take into account instream flow needs for American shad migration, spawning, and nursery use, and minimize deviation from natural flow regimes; and
4. when considering options for restoring alosine habitat, include study of impacts and possible alteration of dam-related operations to enhance river habitat.

The U.S. Fish and Wildlife Service (Service) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the projects.

Specific to American shad, the Service's goal is:

Minimize current and potential negative project operation effects on American shad spawning and recruitment.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq.*), the Silvio O. Conte National Fish and Wildlife Refuge Act (P.L. 102-212; H.R. 794), the Federal Power Act (16 U.S.C. §791a, *et seq.*), the Atlantic States Marine Fisheries Compact (P.L. 539, 77th Congress, as amended by P.L. 721, 81st Congress), and the Atlantic Coastal Fisheries Cooperative Management Act (16 U.S.C. 5107).

Public Interest

The requestor is a resource agency.

Existing Information

Since the construction of the first fish lift facility at Holyoke Dam in 1967, American shad have had access to spawning and rearing habitat upstream from Holyoke Dam. A number of improvements to the Holyoke fishway have occurred since that time, but while the numbers of shad lifted at Holyoke have reached as much as 721,764, and the overall shad population to the river exceeded 1.6 million shad in 1992 (CRASC 1992), total shad population, and numbers of shad passing Turners Falls and Vernon Dam have not met CRASC management plan objectives. Population number and passage numbers past Holyoke have declined substantially from those totals in recent years, with average Holyoke passage numbers over the last 10 years of 211,850. Since historically approximately half of the returning population of shad to the river passed upstream of Holyoke, recent returns are far below management goals. Effective upstream and downstream passage and successful in-river spawning and juvenile production are necessary to help achieve shad management goals for the Connecticut River.

American shad broadcast spawn in congregations over shallow flats and rocky or sandy substrates (Mansuetti and Kolb 1953) at depths less than 10 feet and often far shallower with spawning fish swimming vigorously near the surface in a closely packed circle (Marcy 1972; MacKenzie *et al.* 1985). Fertilized eggs drift downstream until hatching (MacKenzie *et al.* 1985).

American shad are known to spawn downstream from the Turners Falls Project. Layzer (1974) identified six spawning sites from an area below the mouth of the Deerfield River (river mile 191.9) to river mile 161.7 below the Mill River in Hatfield, Massachusetts. Kuzmeskus (1977) verified 16 different spawning sites ranging from downstream of the Cabot tailrace to just upstream of the Holyoke Dam (river mile 87.1). The only parameter that all spawning sites had in common was current (Kuzmeskus 1977). The Service is not aware of any more recent studies that document whether these 16 sites are still viable spawning locations for shad. We are not aware of any studies that have determined American shad spawning habitat or spawning sites upstream of Vernon Dam to Bellows Fall Dam (historic extent of upstream range).

FirstLight Power conducted studies in the late spring and summer of 2012, and examined habitat conditions downstream of the Turners Falls Dam. The study documented that in low flow conditions, Cabot Station project operations produced fluctuations in water level elevations that can range over 4 feet in magnitude (daily operation) at the USGS Montague Gage Station, to lower values of 2 to 3 feet at the Route 116 Bridge, Sunderland, Massachusetts (PAD). Similar short-term, limited monitoring in the upper Turners Falls Dam impoundment identified water level changes due to project operations that cyclically varied several feet on a sub-daily frequency.

Nexus to Project Operations and Effects

American shad are known to spawn at five locations downstream from the Turners Falls Project from an area below the mouth of the Deerfield River (river mile 191.9) and ten other locations downstream to river mile 161.7 below the Mill River in Hatfield (Layzer 1974; Kuzmeskus 1977).

Shad spawning is likely influenced by river flow, which fluctuates greatly due to the project's peaking mode of operation. These fluctuations may impact shad spawning activity by altering current velocities and water depth at the spawning sites. Effects on spawning behavior could include suspension of spawning activity, poor fertilization, flushing of eggs into unsuitable habitat due to higher peaking discharges, eggs dropping out into unsuitable substrate and being covered by sediment deposition, and/or eggs becoming stranded on dewatered shoal areas as peak flows subside.

While a number of shad spawning and egg deposition studies were conducted in the 1970s, that research was aimed at assessing the potential impact of developing a nuclear power station in the Montague Plains section of the Connecticut River. The Service is not aware of any studies being conducted to assess the relationship between spawning behavior, habitat use and egg deposition, and operations of the Turners Falls, NMPS, Vernon and Bellows Falls projects.

The Service is concerned that peaking operations may be altering spawning behavior and contributing to the failure of the Connecticut River shad population to meet management targets.

Methodology Consistent with Accepted Practice

The first year of study should examine known spawning areas downstream of the Turners Falls Dam project, to determine operation effects on shad spawning behavior, activity, and success. In areas upstream of Turners Falls Dam to the Bellow Falls Dam tailrace, the study should identify areas utilized for spawning by American shad. In the second year, should results from year one determine project operations affected spawning activity, access to habitat, or success downstream of Turners Falls Dam, an identical more detailed assessment (identified objectives) should be conducted in spawning areas upstream of Turners Falls Dam to the Bellows Falls Dam tailwater. Measures to reduce or eliminate any documented project operation impacts should be explored and evaluated in year two downstream of Turners Falls Dam.

The impacts to spawning behavior would best be studied by nighttime observations of actual in-river spawning behavior (Ross *et al.* 1993). Project discharge increases or decreases during actual observed spawning activity will provide empirical evidence of change in behaviors. The observational methodology should follow the protocol specified in Layzer (1974) and/or as described in Ross *et al.* (1993). The analysis should utilize the observational field data in conjunction with operational data from the projects (station generation and spill on a sub-hourly basis). To assess the impacts of changes in generation flows, the study should include scheduled changes in project operation to ensure that routine generation changes that occur during the nighttime spawning period affect downstream spawning habitats selected for study while shad are spawning. Stier and Crance (1985) provide optimal water velocities during spawning to range between 1 to 3 ft/sec.

In areas used for spawning, the characteristics of those areas (e.g., location, depth, flow, substrate) should be recorded. The effect of project operations (discharge, water velocity, inundation and exposure) should be assessed. Drift nets will be used to collect eggs to quantify egg production before and after flow changes at the spawning site.

In the reaches above the Turners Falls Dam, nighttime observations of splashing associated with shad spawning should be done in each reach as sufficient numbers of shad are passed above each dam. Observations should be done regularly until the end of the spawning season. The use of radio-tagged adult shad from a separate study request will aid in this effort. An estimate of the total area used for spawning and an index of spawning activity should be recorded for each site.

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

Neither FirstLight nor TransCanada propose any studies to meet this need. Estimated cost for the study is expected to be moderate (up to $40,000) for each owner, with the majority of costs associated with field work labor.

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TransCanada Study Request #5

Telemetry Study of Upstream and Downstream Migrating Adult American Shad to Assess Passage Routes, Effectiveness, Delays, and Survival

(Turners Falls, P-1889; Northfield Mountain, P-2485; Bellows Falls, P-1855; Vernon, P-1904)

Goals and Objectives

Assess behavior, approach routes, passage success, survival, and delay by adult American shad as they encounter the projects during both upstream and downstream migrations, under permitted project operations conditions, proposed operational conditions, and study treatment operational conditions at FirstLight Power's Turners Falls and Northfield Mountain Pumped Storage (NMPS) projects and TransCanada's Vernon Project. There are multiple fishways and issues related to both upstream and downstream passage success at the projects. Some of these issues at the Turners Falls Project are similar to and/or pertain directly to the NMPS and Vernon projects. Therefore, it is reasonable to address passage issues at all projects in a similar manner.

Telemetry Study - This requested study requires use of radio telemetry using both radio and Passive Integrated Transponder (PIT) tag types to provide information to address multiple upstream and downstream fish passage issues. The following objectives shall be addressed in these studies:

1. assessment of any migration delays resulting from the presence of the dam and peaking flow operations of the Turners Falls Project;
2. determine route selection and behavior of upstream migrating shad at the Turners Falls Project under various spill flow levels (e.g., movement to the dam, attraction to Cabot Station, attraction to Station 1 discharge, movement between locations, delay, timing, etc.). A plan and schedule for dam spill flow releases will need to be developed that provides sufficient periods of spill flow conditions, and various generating levels from Turners Falls #1 Station coupled with Cabot Station generation flows (e.g., treatments will require multiple days of consistent discharge). Evaluated spill flows should include flows between 2,500–6,300 cfs, which relate to bypass flows identified as providing spawning opportunities for shortnose sturgeon in the lower bypass reach at the Rock Dam (Kieffer and Kynard 2012). Sturgeon spawning and upstream shad passage occur concurrently;
3. assess near field, attraction to and entrance efficiency of the spillway ladder by shad reaching the dam spillway, under a range of spill conditions;
4. evaluate the internal efficiency of the Turners Falls spillway ladder;
5. continue data collection of Cabot Station ladder and gatehouse ladder efficiency, to include rates of approach to fishway entrances, entry into fishways, and passage through them, under different operational conditions that occur in these areas;
6. evaluate modifications to the Cabot Station and/or spillway fishways recommended by the U.S. Fish and Wildlife Service (Service) if they are implemented;

7. assess upstream migration from Turners Falls to the Vernon Dam in relation to NMPS's pumping and generating operations and Vernon Project peaking generation operations. Typical existing and proposed project operation alterations should be evaluated;
8. assess near field, attraction to and entrance efficiency of the Vernon Dam ladder;
9. assess internal efficiency of the Vernon Dam ladder;
10. assess upstream passage past Vermont Yankee's thermal discharge (also located on the west bank of the river 0.45 mile upstream of fish ladder exit);
11. assess upstream migration from Vernon Dam in relation to the peaking generation operations of the Bellows Falls Project. Typical existing and proposed project operation alterations should be evaluated;
12. determine post-spawn downstream migration route selection, passage efficiency, delays and survival related to the Vernon Project, including evaluation of the impact of the Vermont Yankee heated water discharge plume on downstream passage route, migrant delay/timing, efficiency and survival;
13. assess impacts of NMPS operations on up- and downstream adult shad migration, including delays, entrainment, and behavioral changes and migration direction shifts under existing and proposed project operations;
14. determine downstream passage route selection, timing/delay, and survival under varied project operational flows into the power canal and spill flows at Turners Falls Dam;
15. determine downstream passage route selection, timing/delay in the canal, Cabot Station fish bypass facility effectiveness, and survival of Cabot Station-bypassed adult shad that enter the Turners Falls canal system;
16. compare rates and or measures of delay, movement and survival, etc., among project areas or routes utilized (e.g., spill at dam vs. power canal) under the range of permitted and proposed conditions; and
17. utilize available data sets and further analyze raw data (e.g., 2003-2012 U.S. Geological Survey's Conte Anadromous Fish Research Center [Conte Lab] studies) where possible to address these questions and inform power analyses and experimental design.

Information to address all of these questions would rely on the tagging of upstream migrating adult shad at Holyoke Dam and releasing them to migrate naturally from Holyoke through the Turners Falls and Vernon projects and back downstream after spawning. Additional tagged individuals would likely need to be released farther upstream (Turners Falls canal, upstream of Turners Falls Dam, and upstream of Vernon Dam) to ensure that enough tagged individuals encounter project dams on both upstream and downstream migrations, that these individuals are exposed to a sufficient range of turbine and operational conditions to test for project effects, and to provide adequate sample sizes for statistically valid data analyses to address the many objectives listed. This study will require two years of field data collection to attempt to account for inter-annual variability in river discharge and water temperatures.

<u>Evaluation of Past Study Data</u> - In addition to collection and analysis of new telemetry data, substantial data has already been collected at Turners Falls from multiple years of passage assessments conducted for FirstLight by Conte Lab researchers, and there are also data from the 2011 and 2012 full river study conducted by the Conte Lab that address Turners Falls, NMPS and Vernon project migration and passage questions that have not yet been analyzed. These data include several million records each year from more than 30 radio telemetry receivers deployed

between Middletown, Connecticut and Vernon Dam. This data will provide substantial information free from the field data collection costs and therefore should be analyzed as part of this study. This data analysis should be completed in 2013 to help inform the design of subsequent field studies.

Evaluation of Methods to Get Shad Past Cabot Station for Spillway Passage at the Turners Falls Dam – The poor passage efficiency of the Cabot Station ladder, the first and most used fishway encountered by shad arriving at the Turners Falls Project, and at the entrance to the gatehouse ladder, which all Cabot Station fishway-passed fish must use, has resulted in very poor overall shad passage efficiency at the project. An alternative to passing fish at the Cabot Station is to install a fish lift at the dam that would put fish directly into the Turners Falls pool, thereby eliminating problems with the Cabot Station fishways, and the gatehouse fishway entrance and the variable passage efficiency of the gatehouse fishways. For this to be effective, attraction of shad to the Cabot Station discharge and associated delays would need to be overcome. It is possible that spillway flow releases coupled with behavioral measures at Cabot Station that dissuade shad from that tailrace could achieve this end. In order to assess the possibilities, we recommend the following study:

1. A literature search and desk-top assessment of the possible behavioral measures that could be effective in getting shad to pass Cabot Station tailrace and continue upstream to the dam.
2. Based on results of the desk-top assessment, possible evaluation of behavioral measures that are likely to be effective.
3. Field evaluation of the effect of different levels of spill at the dam that would induce fish to move past the Cabot Station into the bypass reach and up to the dam (as noted in Goals and Objectives).

In addition to passage success and delays at passage facilities, these studies would assess the impacts of project operations on migration passage delay, route, timing, injury, mortality, and passage structure attraction, retention, and success. Of particular interest will be fish behavior: during periods when project flow releases increase from the required minimum to peak generation flows, when they subside from peak generation to minimum flows, and in response to the operation of NMPS in pumping and generation modes.

Resource Management Goals

The Connecticut River Atlantic Salmon Commission (CRASC) developed *A Management Plan for American Shad in the Connecticut River* in 1992. Management Objectives in the plan include the following:

1. achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually;
2. achieve annual passage of 40 to 60 percent of the spawning run (based on a five-year running average) at each successive upstream barrier on the Connecticut River mainstem; and
3. maximize outmigrant survival for juvenile and spent adult shad.

The Atlantic States Marine Fisheries Commission, Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management), approved in 2010, includes the following objective:

Maximize the number of juvenile recruits emigrating from freshwater stock complexes:

Upstream Passage –

1. American shad must be able to locate, enter, and pass the passage facility with little effort and without stress.
2. Where appropriate, improve upstream fish passage effectiveness through operational or structural modifications at impediments to migration.
3. Fish that have ascended the passage facility should be guided/routed to an appropriate area so that they can continue upstream migration, and avoid being swept back downstream below the obstruction.

Downstream Passage –

To enhance survival at dams during emigration, evaluate survival of post spawning and juvenile fish passed via each route (e.g., turbines,, spillage, bypass facilities, or a combination of the three) at any given facility, and implement measures to pass fish via the route with the least delay and best survival rate.

Based on the CRASC plan, the Service seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the projects.

Specific to American shad movement and migration, the Service's goal is:

Minimize current and potential negative project operation effects such as migration delays, false attraction, turbine entrainment, survival of project passage routes, and trashrack impingement that could hinder management goals and objectives.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq.*), the Silvio O. Conte National Fish and Wildlife Refuge Act (P.L. 102-212; H.R. 794), the Federal Power Act (16 U.S.C. §791a, *et seq.*), the Atlantic States Marine Fisheries Compact (P.L. 539, 77th Congress, as amended by P.L. 721, 81st Congress), and the Atlantic Coastal Fisheries Cooperative Management Act (16 U.S.C. 5107).

Public Interest

The requestor is a federal natural resource agency. Migratory species of fish are a trust resource for the Service due to their interjurisdictional movements. Protection and restoration of these fish is a key objective for the Service.

Existing Information

Passage of adult shad at the Turners Falls fishway complex has been the subject of intense study by the Conte Lab since before 1999. These studies have clearly demonstrated that passage through the existing fishways at the Cabot Station and spillway is poor (<10 percent in many years). Passage through the gatehouse fishway is better, but still rarely exceeds 80 percent, despite the short length of this ladder. In addition to poor passage for fish entering the ladders, shad that ascend the Cabot Station fishway experience extensive delays before entry into the gatehouse fishway. Shad that ascend spillway frequently fall back into the canal and are also subject to these upstream delays. A new entrance to the gatehouse fishway installed in 2007 led to dramatic improvements in passage out of the canal (from 5 percent to over 50 percent in 2011), but passage still falls well short of management goals. In addition, shad spend considerable time (up to several weeks) attempting to pass. These delays likely influence spawning success and survival. Adult shad, unable to pass the gatehouse fishway, experience similar delays in downstream passage, even after they have stopped trying to pass the gatehouse fishway. In addition, if there is no spill, all outmigrating shad that have passed upstream must enter the power canal and may be subject to delays exiting the canal.

During the course of these studies, a very large dataset has been compiled that could yield useful information for further improving passage of shad out of the canal in both the upstream and downstream directions. A unique feature of these data is a two-dimensional array covering the canal just downstream of the gatehouse fishway, documenting fine scale movements and occupancy of this zone. These data should be combined with computational fluid dynamics (CFD) and real-time hydraulic data to determine how canal hydraulics influence the ability of shad to locate and enter the fishway, and to identify modifications that are likely to lead to improvements in approach and entry rates. A separate CFD modeling study is requested that includes modeling of the gatehouse fishway entrance area at the head of the power canal.

In addition, whole-river shad telemetry studies performed in 2011 and 2012 will likely provide useful information and should be analyzed. These data should allow quantification of delay below Turners Falls, and could help guide studies requested above. Preliminary analyses of data through 2011 have been made available to FirstLight and the resource agencies (Castro-Santos and Haro 2005; Castro-Santos and Haro 2010).

The whole-river studies have also shown that, at least in 2011, most shad that pass Turners Falls rapidly progress upstream to Vernon Dam where extensive delays also occur. Data from the 2012 study are not available at this time, but Dr. Castro-Santos stated that similar patterns in upstream passage delay were noted in the data from both years (Dr. Theodore Castro-Santos, Conte Lab, personal communication). There are similar concerns relative to downstream passage delays of spent shad, with existing unpublished telemetry data sets suggesting this is an issue within the Turners Falls canal.

Since the first year of operation of the Turners Falls upstream fishways (1980), an average of only 3.6 percent of American shad that passed upstream of the Holyoke Dam have successfully passed the Turners Falls Dam. The highest values for this metric has not exceed 11 percent, and are well below the noted CRASC Management Plan target range for this objective, noted earlier as 40-60 percent on a five-year running average.

Since the first year of operation of the Vernon Dam upstream fish ladder (1981), the percent passage of American shad annually passed at the Vernon Project compared to the number passed upstream of Turners Falls Dam (gatehouse counts) has averaged 39.4 percent, ranging from 0.42 percent to 116.4 percent (>100 percent due to a counting error at one or both facilities, unknown).

Nexus to Project Operations and Effects

Existing project operations (peaking power generation) and limited bypass flows have a direct impact on instream flow and zones of passage (migration corridors). Project flow releases affect passage route selection, entry into fishways, and create delays to upstream migration. Inefficient downstream bypasses can result in migration delays and increased turbine passage. Mortality of adult shad passing through these turbines is expected to be high (Bell and Kynard 1985). In addition, stresses associated with passage and delay may cause mortality as shad are unable to return to salt water in a timely manner. The project's upstream and downstream passage facilities need to be designed and operated to provide timely and effective upstream and downstream fish passage to meet restoration goals of passage to upstream habitat and maximize post-spawn survival. These factors are all critically important to the success of restoration efforts.

Methodology Consistent with Accepted Practice

Use of radio, including passive-integrated transponder (PIT) telemetry, is widely accepted as the best method to assess fish migratory behavior and passage success, and has been used extensively to assess migration and passage issues at Turners Falls, as well as other Connecticut River projects. These studies include one conducted in 2011 and 2012 by the Service and the Conte Lab, which has provided substantial information related to some of the issues identified here. The requested study will build and expand on the information collected over the past two years.

The study design must specify sample sizes, tag configurations and receiver configurations, to ensure that rates of entry and exit to the tailraces, fishways, downstream bypasses, and the bypassed reach can be calculated with sufficient precision to determine effectiveness of flow and ensonification treatments (separate study request). For project assessments at Turners Falls (e.g., Cabot Station, spillway and gatehouse ladder attraction and entry, route selection, operational effects), double-tagged (radio and PIT) shad will be required for release from Holyoke Dam. Additional shad must be released directly into the Turners Falls canal to adequately assess the various project generation and fish passage operational and structural conditions likely to be encountered by shad.

A related request on CFD modeling in the Cabot Station tailrace, the upper power canal near the gatehouse fishway, and in the area around the entrance of the spillway ladder, will address related project operational effects that will also address identified objectives in this telemetry request. Shad captured at the Holyoke Project and tagged and released upstream of Turners Falls Dam, or tagged out of the gatehouse ladder, would help to ensure an adequate sample size to evaluate the impacts of the NMPS and Vernon projects on passage and delay.

Additional tagged shad are expected to be required for release upstream of the Vernon Dam to ensure adequate sample size to assess where shad spawn upstream of Vernon Dam (see separate study request), as well as to ensure that there is an adequate number of outmigrating spent adults to address downstream passage questions.

Existing information on captured, handled, tagged fish performance (e.g., percent that drop back, unsuitable for tracking) and factors such as timing of tagging and potentially transport, must all be carefully considered to ensure an adequate sample size of healthy (e.g., viable to characterize behavior, survival, etc.) tagged fish is available to address the many questions identified in this request (as supported by a statistical power analysis). Additionally, it will be important to ensure that an adequate number of tagged shad are available to address the downstream passage questions above, as expected losses of healthy tagged fish during upstream passage, natural mortality rates, and due to tagging-related effects are expected to reduce fish available for these assessments. The use of single PIT-tagged fish can help improve sample sizes, but will be of limited use to answer some of the passage questions we have identified.

Due to environmental variability, two years of study work will be necessary. A large array of stationary monitoring stations (radio and PIT) will be needed to address the issues identified among the project areas. A sufficient level of radio receiver and PIT reader coverage will be required, to provide an appropriate level of resolution, for data analyses, to answer these questions on project operational effects. The study will provide information on a variety of structural and operational aspects of fish migration, relative to route selection, timing, survival, and up- and downstream passage attraction, retention, delay, efficiency, survival as some examples at three projects (Turners Falls, NMPS, and Vernon). The use of video monitoring may also be utilized for specific study areas such as the spillway ladder to provide additional information on shad entrance activity, with the understanding of some data limitations associated with this approach (fish identification, water visibility).

In addition to the tagging studies, use of video monitoring of the spillway fishway would provide additional overall data on its efficiency as all shad attempting to pass could be monitored versus just those shad that have been tagged.

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

The requested study is extensive and will require a substantial effort and cost to capture, PIT tag, and radio tag a sufficient number of shad at the Holyoke Project to release at upstream locations. We are not aware of any other study technique that would provide project-specific fish behavior and migration information to adequately assess existing project operations and provide insight in possible alternative operations and measures needed to address observed negative impacts to fish migration success. Cost for the entire multi-project tagging, tracking and data analysis are expected to range from $400,000 to $500,000, based on past Turners Falls studies and the 2011 and 2012 shad telemetry studies. Video monitoring of the spillway fishway would add a modest cost to this study.

Due to the fact that tagged shad will move throughout the larger five project area, to varying degrees, there will be expected cost savings (e.g., radio tags) to both owner/operators, provided cooperation in study planning and implementation occurs.

REFERENCES

Atlantic States Marine Fisheries Commission. 2010. Amendment #3 to the interstate fishery management plan for shad and river herring (American shad management). Washington, D.C.

Bell, C. E. and B. Kynard. 1985. Mortality of adult American shad passing through a 17-megawatt Kaplan turbine at a low-head hydro-electric dam. North American Journal of Fisheries Management, 5:33-38.

Castro-Santos, T. and A. Haro. 2005. Turners Falls fish passage studies 2005: results from PIT and radio telemetry studies. CAFRC Internal Report # 2005-04.

Castro-Santos, T. and A. Haro. 2010. Gatehouse fishway telemetry studies: progress report, 2008-2010. USGS CAFRC Internal Report.

Kieffer, M. and B. Kynard. 2012. Spawning and non-spawning migrations, spawning, and effects of river regulation on spawning success of Connecticut River shortnose sturgeon. In Life history and behavior of Connecticut River shortnose sturgeon and other sturgeons. B. Kynard, P. Bronzi and H. Rosenthal Editors. World Sturgeon Conservation Society: Special Publication #4. Norderstedt, Germany.

TransCanada Study Request #6

Impact of Vernon Project Operations on Downstream Migration of Juvenile American Shad
(Vernon, P-1904)

Conduct a field study of juvenile American shad outmigration at the Vernon Dam to determine if project operations negatively impact juvenile shad survival and production.

Goals and Objectives

Determine if project operations affect juvenile American shad outmigration survival, recruitment, and production. The following objectives will address this request:

1. assess project operation effects of Vernon Dam on the timing, routes, migration rates, and survival of juvenile shad;
2. determine the proportion of juvenile shad that, as a downstream passage route, choose or are directed to existing downstream bypass structures, gate structures, or are entrained into the station turbines, and assess delay, survival, timing, and related impacts with these locations under a full range of operational conditions over the period of outmigration; and
3. determine survival rates for juvenile shad entrained into Vernon Station units.

If it is determined that the project operations or related effects are adversely affecting juvenile shad survival, migration timing, or other deleterious population effects are noted, identify operational solutions or other solutions that will reduce and minimize impacts, within the project affected area. This study will require two years of field data to capture inter-annual variability of river discharge, water temperature, and variability in run size and juvenile production (and timing of developmental stages) and variability in outmigration timing which may relate to spring, summer and fall conditions.

Resource Management Goals

The Connecticut River Atlantic Salmon Commission (CRASM) developed *A Management Plan for American Shad in the Connecticut River* in 1992. Management Objectives in the plan include the following:

1. Achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually.
2. Maximize outmigrant survival for juvenile and spent adult shad.

The Atlantic States Marine Fisheries Commission Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management), approved in 2010, includes the following objective:

Maximize the number of juvenile recruits emigrating from freshwater stock complexes.

The U. S. Fish and Wildlife Service (Service) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the project.

Specific to American shad, the Service's goal is:

Minimize current and potential negative project operation effects on juvenile American shad survival, production, and recruitment.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

Public Interest

The requestor is a resource agency.

Existing Information

Adult shad are counted annually as they pass above the Vernon Dam. Juvenile American shad production has been monitored upstream of the Vernon Dam and immediately downstream of that dam by Vermont Yankee Nuclear as part of an annual monitoring program using both boat electrofishing (since 1991) and beach seining (since 2000). A seasonal average annual index of juvenile American shad standing crop in the Vernon reservoir has been calculated since 2000. Estimates of juvenile shad growth rates in the Vernon impoundment have been calculated annually beginning in 2004, and also in a study conducted in 1995 (Smith and Downey 1995).

Numerous studies of the effectiveness of downstream passage facilities at the Vernon Project have been conducted for Atlantic salmon smolts. Studies of American shad passage were limited to tests in 1991 and 1992 of a high frequency sound field to guide fish to the fish pipe, the primary downstream fishways in 1991 and 1992 (RMC Environmental Services, Inc. 1993) and an attempt to determine passage route of juvenile shad using hydroacoustics in 2010 following the replacement of units 5 through 8.

Although the high frequency sound studies were deemed incomplete, the technology indicated some level of response by juvenile shad. However, despite that conclusion, there is no indication that this technology or other downstream passage studies with juvenile shad were subsequently pursued.

The hydroacoustic assessment of passage route was conducted to fulfill a requirement of the 2006 license amendment that authorized the unit replacements to assess downstream passage effectiveness for juvenile shad. The hydroacoustic study was deemed unsuccessful, but no follow-up assessment was made, due to the limited viable assessment tools available at that time. However, new, very small radio tags make assessment of juvenile shad passage now achievable.

Nexus to Project Operations and Effects

Juvenile American shad production occurs in the river reach between the Vernon Dam and the Bellows Falls Dam, which is thought to be the historic upstream limit of the shad migration in the Connecticut River. Juvenile American shad require safe and timely downstream passage measures to have the opportunity to contribute to the restoration target population size.

There is little information available regarding the total impact of the Vernon Project on downstream migration of juvenile shad. Migration delays, increased predation, mortality during passage over the dam or through turbines, and changes in route selection under different flow conditions are potential influences of the Vernon Dam on the juvenile shad population in the upper Connecticut River. Effective upstream and downstream passage and successful in-river spawning and juvenile production are necessary to help achieve shad management restoration goals for the Connecticut River, particularly in the upstream reaches. Delays in juvenile American shad outmigration may affect survival rates in the transition to the marine environment (Zydlewski *et al.* 2003).

Methodology Consistent with Accepted Practice

The impact to juvenile shad outmigrants would be best studied by a combination of approaches, including hydroacoustics, radio telemetry (including passive integrated transponder [PIT] telemetry), and turbine balloon tags. Project discharge adjustments at the dam should be examined relative to timing, duration, and magnitude of juvenile shad migration to and through the dam, with hydroacoustic equipment for natural/wild fish information. In addition, study fish should be collected and tagged (PIT, radio, balloon) to then empirically determine rates of survival for fish passed through the project under varied operations, from minimum flows up to full spill conditions. The release of tagged fish (radio, PIT) at a number of potential sites will provide data on delay and route selection as juvenile shad move through the Vernon project area. The number and location of release sites will depend on the availability of tagged fish.

Additional hydroacoustic assessment immediately upstream and downstream of the Vernon Dam will provide information on the timing of migration to and through this area. A more focused survival study, using balloon tags, PIT tags, or other appropriate methods, should be conducted in the second year based upon the first year of study findings relative to the frequency, magnitude, timing, and route selection of juvenile American shad through the Vernon Project.

Level of Effort/Cost, and Why Alternative Studies will not suffice

TransCanada does not propose any studies to meet this need. Estimated cost for the study is expected to be up to $150,000, with the majority of costs associated with equipment (hydroacoustic gear, radio tags, radio receivers, and PIT readers) and related field work labor.

REFERENCES

RMC Environmental Services, Inc. 1993. Effect of ensonification on juvenile American shad movement and behavior at Vernon Hydroelectric Station, 1992 – Draft Report, March 1993.

Smith, R. L. and P. C. Downey. 1995. Vermont Yankee/Connecticut River System Analytical Bulletin 69: Relative density and growth of juvenile American shad in the Connecticut River near Vernon, Vermont, 1995.

Zydlewski, J., S. D. McCormick and J. G. Kunkel. 2003. Late migration and seawater entry is physiological disadvantageous for American shad juveniles. Journal of Fish Biology #63, 1521-1537.

TransCanada Study Request #7

Shad Population Model for the Connecticut River

(Turners Falls, P-1889; Northfield Mountain, P-2485;
Bellows Falls, P-1855; Vernon, P-1904)

Develop an American shad annual step, mathematical simulation population model for the Connecticut River to quantify how project operations and potential restoration/mitigation measures impact the population of shad in the Connecticut River.

Goals and Objectives

The goal of the model is to assess impacts of both upstream and downstream passage at each of the Connecticut River projects and potential management options for increasing returns to the river.

Specific objectives include:

1. annual projections of returns to the Connecticut River;
2. a deterministic and stochastic option for model runs;
3. life history inputs of Connecticut River shad;
4. understanding the effect of upstream and downstream passage delay at projects;
5. calibration of the model with existing data;
6. analysis of the sensitivity of model inputs;
7. analysis of sensitivity to different levels of up- and downstream passage efficiencies at all projects; and
8. multiple output formats including a spreadsheet with yearly outputs for each input and output parameter.

Resource Management Goals

The Connecticut River Atlantic Salmon Commission (CRASC) developed *A Management Plan for American Shad in the Connecticut River* in 1992. Management objectives in the plan include the following:

1. Achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually.
2. Achieve annual passage of 40 to 60 percent of the spawning run (based on a five-year running average) at each successive upstream barrier on the Connecticut River mainstem.
3. Maximize outmigrant survival for juvenile and spent adult shad.

The U.S. Fish and Wildlife Service (Service) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the projects.

Specific to American shad, the Service's goal is:

Minimize current and potential negative project operation effects on American shad spawning and recruitment.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

Public Interest

The requestor is a natural resource agency.

Existing Information

Since the construction of the first fish lift facility at Holyoke Dam in 1967, American shad have had access to spawning and rearing habitat upstream from Holyoke Dam. A number of improvements to the Holyoke fishway have occurred since that time, but while the numbers of shad lifted at Holyoke have reached as much as 721,764 and the overall shad population to the river exceeded 1.6 million shad in 1992 (CRASC 1992), total shad populations, and numbers of shad passing Holyoke, Turners Falls and Vernon Dam have not met CRASC management goals.

Population and passage numbers past Holyoke have declined substantially from those totals in recent years, with average Holyoke passage numbers since 2000 of 229,876. Whole river population estimates have shown that approximately half of the returning population of shad pass upstream of Holyoke. Recent returns to Holyoke are far below management goals. Average passage efficiency of shad at Turners Falls (gatehouse counts) and Vernon since 2000 has been 3.1 and 20.4 percent, respectively. These too are well below the CRASC management goals.

Safe, timely and effective up- and downstream passage, along with successful spawning and juvenile production, are necessary to help achieve shad management goals for the Connecticut River.

Nexus to Project Operations and Effects

Existing project operations and fish ladder efficiencies have a direct effect on shad populations in the Connecticut River. Poor upstream passage efficiencies and delays restrict river access to returning shad. Fish unable to reach upriver spawning grounds may not spawn or have reduced fitness or survival of young. Poor downstream passage survival and downstream passage delays affect outmigration and consequently repeat spawning, an important ecological aspect of the iteroparous Connecticut River shad population (Limberg *et al.* 2003).

The Service is concerned that poor passage efficiencies and delays at projects may be limiting access to upstream reaches of the river, altering spawning behavior, decreasing outmigration survival and contributing to the failure of the Connecticut River shad population to meet management targets (Castro-Santos and Letcher 2010).

Development of a population model will allow an assessment of individual project impacts on the population as well as the cumulative impacts of multiple projects. The model will allow managers to direct their efforts in the most efficient manner toward remedying the conditions that most impact the shad population.

Methodology Consistent with Accepted Practice

Population models are commonly used to assess anthropomorphic and natural impacts and are consistent with accepted practice. A model similar to this request was constructed for the Susquehanna River by Exelon (FERC No. 405). The model is constructed in Microsoft Access.

Specific parameters that would be included in the model:

1. upstream passage efficiency at Holyoke, Turners Falls (Cabot, gatehouse and spillway
2. ladders), Vernon fishways, and any impacts associated with Northfield Mountain Pumped Storage;
3. distribution of shad approaching the Turners Falls Project between the Cabot ladder and the spillway at the dam;
4. downstream passage efficiencies at Vernon, Northfield Mountain Pumped Storage, Turners Falls, and Holyoke projects for juveniles and adults;
5. entrainment at Mount Tom Power Plant and Vermont Yankee Nuclear Power Plant;
6. sex ratio of returning adults;
7. the proportion of virgin female adults returning at 4, 5, 6, and 7 years;
8. the proportion of repeat spawning females at 5, 6 and 7 years;
9. spawning success of females in each reach;
10. fecundity;
11. percent egg deposition;
12. fertilization success;
13. larval and juvenile in-river survival;
14. calibration factor to account for unknown parameters such as at sea survival;
15. options for fry stocking and trucking as enhancement measures;
16. start year and model run years;
17. start population;
18. rates of movement to and between barriers; and
19. temperature, river discharge, and other variables of influence to migration and other life history events.

The model should be adaptable to allow the input of new data and other inputs.

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

Neither FirstLight nor TransCanada have proposed any study to meet this need. Estimated cost for the study is expected to be low to moderate. As the model describes the impacts of multiple projects and two owners, both project owners would share the cost of model development.

REFERENCES

CRASC (Connecticut River Atlantic Salmon Commission). 1992. A management plan for American shad in the Connecticut River basin. Sunderland, MA.

Castro-Santos, T. and B. H. Letcher. 2010. Modeling migratory bioenergetics of Connecticut River American shad (*Alosa sapidissima*): implications for the conservation of an iteroparous anadromous fish. Can.J.Fish.Aquat.Sci. 67: 806-830.

Limberg, K. E., K. A. Hattala and A. Kahne. 2003. American shad in its native range. Pages 125-140 in K. E. Limberg and J. R. Waldman, editors. Biodiversity, status and conservation of the world's shads. American Fisheries Society, Symposium 35, Bethesda, Maryland.

TransCanada Study Request #8

American Eel Survey
Upstream of the Vernon, Bellows Falls, and Wilder Dams

(Bellows Falls, P-1855; Wilder, P-1892; Vernon, P-1904)

Goals and Objectives

The goal of this study is to provide baseline data relative to the presence of American eel upstream of the Vernon, Bellows Falls, and Wilder dams.

The objective of the study is to determine the relative abundance and distribution of American eel upstream of the Vernon, Bellows Falls and Wilder dams in both riverine and lacustrine habitat.

Resource Management Goals

The Atlantic States Marine Fisheries Commission (ASMFC) has developed two documents related to the management of American eel:

1. Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.
2. Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

Objectives of the management plan include: (1) protect and enhance American eel abundance in all watersheds where eel now occur; and (2) where practical, restore American eel to those waters where they had historical abundance but may now be absent by providing access to inland waters for glass eel, elvers, and yellow eel, and adequate escapement to the ocean for pre-spawning adult eel.

Addendum II contains specific recommendations for improving upstream and downstream passage of American eel, including requesting that member states and jurisdictions seek special consideration for American eel in the Federal Energy Regulatory Commission (Commission) relicensing process.

In addition, the Connecticut River Atlantic Salmon Commission (CRASC) developed A Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin in 2005. The goal of the plan is "to protect and enhance the abundance of the American eel resource to ensure its continued role in the Connecticut River Basin ecosystem..." Management objectives in the plan include the following:

1. protect and enhance eel populations where they currently exist;
2. where practical, restore populations to waters where they had historical abundance;
3. provide effective upstream and downstream fish passage around dams and other barriers within the species' range in the basin; and

4. comply with all requirements of the Fishery Management Plan of the ASMFC.

Based on these plans, the U.S. Fish and Wildlife Service (Service) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the projects.

Specific to American eels, the Service's goals are:

1. Protect, enhance, or restore diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Understand the baseline condition with respect to the presence of American eel within and upstream of the project areas.
3. Minimize current and potential negative project operation effects on American eel inhabiting the project areas and/or moving through the areas during upstream and downstream migrations.

The American eel (*Anguilla rostrata*) is also listed as one of both New Hampshire's and Vermont's Species of Greatest Conservation Need (SGCN). The status for conservation need in Vermont is listed as high priority (Kart *et al.* 2005), and the species is listed as "vulnerable" in New Hampshire. As identified in Vermont's Wildlife Action Plan (Kart *et al.* 2005), threats to the species include the construction of large dams on rivers which obstruct juvenile fish access to critical rearing habitats, as well as mortality associated with passing through hydroelectric facilities' turbines during their outmigration to sea.

As outlined in Vermont's Wildlife Action Plan (Kart *et al.* 2005), research and monitoring needs for this SGCN include determining their distribution and abundance, as the contribution of eels in northern regions to overall stock is unknown. One of the conservation strategies for this species is to support efforts to enhance access of American eels to Vermont waters by eliminating or minimizing impacts of dams and other obstructions along the Richelieu, St. Lawrence, and Connecticut rivers.

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

Public Interest

The requester is a natural resource agency.

Background and Existing Information

According to the PAD, very few American eels were collected in the Fish Assemblage and Habitat Assessment of the Upper Connecticut River (Yoder *et al.* 2009). In the Vernon Project area upstream of the dam, only one eel was collected; no eels were collected from the Bellows Falls pool, and none were found upstream of the Wilder Dam. However, in 2012, over 200 eels were documented using the upstream fish ladder at the Vernon Project, and the New Hampshire Fish and Game Department has observed eels upstream of the Bellows Falls and Wilder dams. More recently, eels have been observed in Lake Morey, Vermont, which is located upstream of Wilder Dam (Lael Will, VDFW, personal communication). Therefore, while it is clear that some eels are passing all three dams (Vernon, Bellows Falls, and Wilder), it remains unknown how many eels may be rearing in the mainstem habitat upstream of the dams or in tributaries and lakes and ponds that feed into the mainstem river.

No targeted eel surveys have been conducted to determine the abundance and distribution of American eels in riverine and lacustrine habitat upstream of the three projects. This information gap needs to be filled so resource agencies can properly evaluate the need for, and timing of, downstream passage and protection measures for outmigrating silver phase eels.

It should be noted that within the past seven years, the Service has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005, the Service issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability (CESAR). On September 29, 2011, the Service issued a substantial 90-day finding and initiated a 12-month status review. The Service is still accepting new American eel information for the ongoing status review. The Service also is currently in settlement negotiations with CESAR on their legal complaint that the Service failed to complete the 12-month finding within the statutory timeframe. It is likely that the Service's 12-month finding on the latest petition will be made prior to any new licenses being issued for the projects.

Nexus to Project Operations and Effects

The project configurations present problems with respect to providing safe, timely and effective passage for outmigrating eels. The intakes are deep and, while no specification for the trashracks were provided in the PAD, it is unlikely that they would prevent impingement and/or entrainment of eels. Existing anadromous downstream passage facilities at the projects also would not be expected to be effective for eels; the target anadromous species are surface-oriented, while eels tend to move much deeper in the water column. If eels are utilizing habitat upstream of the dams, appropriate protection and downstream passage measures will be needed.

In order to understand the need for, and timing of, downstream eel passage at the projects, we are requesting that TransCanada undertake eel surveys in the Connecticut River upstream of the three dams and in tributaries feeding into the mainstem river within the project areas. Surveying tributary habitat is necessary because surveying the mainstem alone may lead to an underestimation of eel abundance, particularly if there are relatively short tributary streams that lead to a lake or pond (where eels may accumulate, leading to true high densities).

Methodology Consistent with Accepted Practice

The Service requests an eel survey be conducted in the mainstem river and tributaries upstream from the three projects. The methodology should be similar to that used in the relicensing of the Saluda Hydroelectric Project, FERC No. 516,[1] the eel assessment for the Merrimack River completed by the Service's Central New England Fishery Resources Office, and the proposed study plan for the relicensing of the Eastman Falls Project (FERC No. 2457).[2]

In general, a combination of electroshocking (backpack in wadeable rivers and boat-mounted in larger rivers and lakes) and eel pots should be used to collect eels and determine catch rates. Sampled habitat should include: the mainstem Connecticut River from upstream of Vernon Dam to below the Ryegate Dam; tributaries to the Connecticut within that stretch where eels have been collected previously; and lakes and ponds (such as, but not limited to, Spofford Lake and Lake Morey) where eels have been collected previously. Sampling should occur during the summer (July through September).

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

The expected level of effort and anticipated costs will be comparable to those experienced on similar Commission projects of this size. A study plan recently submitted for the Eastman Falls Project (FERC No. 2457) on the Pemigewasset River in New Hampshire, which is utilizing a similar methodology, estimated that sampling a nine-mile-long impoundment with shocking and eel pots would cost $25,000. They estimated the effort to be two nights for the electrofishing survey. Given the much larger area that will need to be sampled under this request, we estimate moderate cost and effort will be required (20 days of shocking mainstem habitat plus another 5-10 days for tributaries and associated lake/pond habitat).

REFERENCES

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar and B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department. Waterbury, Vermont. http://www.vtfishandwildlife. com/ swg_cwcs_report.cfm. (Accessed September 10, 2012).

Yoder, C.O., L.E. Hersha and B. Appel. 2009. Fish assemblage and habitat assessment of the Upper Connecticut River: preliminary results and data presentation. Final Project Report to: U.S. EPA, Region 1, Boston, MA. Center for Applied Bioassessment & Biocriteria. Midwest Biodiversity Institute. Columbus, OH.

1 In a letter from the U.S. Fish and Wildlife Service on the Eastman Falls Project, FERC 2457, FERC Accession No. 20121031-0007.

2 FERC Accession No. 20121214-5121.

TransCanada Study Request #9

Upstream American Eel Passage Assessment at Vernon, Bellows Falls and Wilder Projects

(Bellows Falls, P-1855; Wilder, P-1892; Vernon, P-1904)

Goals and Objectives

This study has two objectives:

1. Conduct systematic surveys of eel presence/abundance at tailrace and spillway locations at the Vernon, Bellows Falls, and Wilder projects to identify areas of concentration of eels staging in pools or attempting to ascend wetted structures that would potentially establish the most effective locations to place upstream eel passage facilities.

2. Collect eels with temporary trap/pass devices from areas identified from surveys as potential locations of eel concentration to assess whether eels can be collected/passed in substantial numbers, and whether locations are viable sites for permanent eel trap/pass structures.

Resource Management Goals

The Atlantic States Marine Fisheries Commission (ASMFC) has developed two documents related to the management of American eel:

1. Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.
2. Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

In addition, the Connecticut River Atlantic Salmon Commission (CRASC) developed the draft document: A Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin in 2005. The goal of the plan is "to protect and enhance the abundance of the American eel resource to ensure its continued role in the Connecticut River Basin ecosystem…" Management objectives in the plan include the following:

1. protect and enhance eel populations where they currently exist;
2. where practical, restore populations to waters where they had historical abundance;
3. provide effective upstream and downstream fish passage around dams and other barriers within the species' range in the basin; and
4. comply with all requirements of the Fishery Management Plan of the ASMFC.

Based on these plans, the U.S. Fish and Wildlife Service (Service) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the three projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the projects.

Specific to upstream passage of American eel, the Service's goals are:

1. Minimize current and potential negative project operation effects that could hinder management goals and objectives.
2. Minimize project-related sources of upstream passage delay, injury, and stress in order to facilitate access to historical rearing habitat.

The American eel (*Anguilla rostrata*) is also one of New Hampshire and Vermont's Species of Greatest Conservation Need (SGCN). The status for conservation need in Vermont is listed as high priority (Kart *et al.* 2005), and the species is listed as "vulnerable" in New Hampshire. As identified in Vermont's Wildlife Action Plan (Kart *et al.* 2005), threats to the species include the construction of large dams on rivers which obstruct juvenile fish access to critical rearing habitats, as well as mortality associated with passing through hydroelectric facilities' turbines during their outmigration to sea.

As outlined in Vermont's Wildlife Action Plan (Kart *et al.* 2005), research and monitoring needs for this SGCN include determining their distribution and abundance, as the contribution of eels in northern regions to overall stock is unknown. One of the conservation strategies for this species is to support efforts to enhance access of American eels to Vermont waters by eliminating or minimizing impacts of dams and other obstructions along the Richelieu, St. Lawrence, and Connecticut rivers.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

Public Interest

The requester is a natural resource agency.

Existing Information

The PADs contain no information relative to areas where eels seeking to move upstream concentrate downstream of the three dams, or annual numbers of eels attempting to ascend past the dams. While eels have been known to ascend the Vernon and Bellows Falls fish ladders, their efficiency for passing eels is unknown, and they are only operated during the American shad passage season (from April 15 through July 15). Eels are currently able to pass Vernon, Bellows Falls, and Wilder dams (as evidenced by documented presence of eels upstream), but the total number of eels attempting to pass all three dams and the proportion successfully passing each project is unknown (but suspected to be low). The downstream Holyoke Project has operated upstream eel passage facilities since 2004. Last year, these facilities passed over 40,000 juvenile eels. While the next dam upstream (Turners Falls Project, FERC No. 1889) has no dedicated upstream eel passage facilities, eels have been known to ascend the Cabot Station fish ladder (A. Haro, U.S. Geological Survey, personal communication). Although there is rearing habitat in between the Turners Falls and Vernon dams, some eels will attempt to continue upstream, and passage needs to be provided so these fish can access historical habitat.

These information gaps need to be filled so resource agencies can determine the best locations to site upstream eel passage facilities and assess whether operating the existing anadromous ladders would be an effective mechanism to move juvenile eels upstream past the projects.

We also note that within the past seven years, the Service has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005, the Service issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability (CESAR). On September 29, 2011, the Service issued a substantial 90-day finding and initiated a 12-month status review. The Service is still accepting new American eel information for the ongoing status review. The Service also is currently in settlement negotiations with CESAR on their legal complaint that the Service failed to complete the 12-month finding within the statutory timeframe. Although the date for completion of the Service's 12-month finding on the latest petition is uncertain, it is likely that it will be made before any new licenses are issued for the projects.

Nexus to Project Operations and Effects

The three projects generate hydropower on the head created by the Vernon, Bellows Falls, and Wilder dams. These dams create barriers to upstream migrating eels. While some eels are able to pass dams, some are not, and the passability of a given dam depends on factors such as its height, hydraulics, presence of climbable surfaces, presence of predators, risk of exposure to heat or drying while climbing a dam, etc. All three dams are high (Vernon: 58 ft. high; Bellows Falls: 30 ft. high; and Wilder: 60 ft. high), and the majority of the dam faces are dry during most of the upstream eel passage season. Design of the dams is not currently amenable to passage of eels by climbing. As mentioned earlier, the existing anadromous passage facilities are not designed to pass eels, and even if some eels are able to ascend the ladders, they may incur delays (in attraction or passage rates), be size-selective (e.g., velocity barrier for small eels presented by ~8 ft/sec flow through weirs and orifices), present a potential predation risk (predators in or near the fishways), and are not operated throughout the upstream eel passage season.

Methodology Consistent with Accepted Practice

1. Objective 1: Systematic Surveys

Surveys of eel presence and relative abundance should be conducted at regular intervals throughout the eel upstream migratory season (~1 May to ~15 October, or when river temperatures exceed 10°C). Surveys should consist of visual inspection and trapping in likely areas where eels may concentrate as they attempt to climb structures wetted by significant spill or leakage flow below the dams and associated structures. These locations include the upstream fish ladders at all three projects (dewatered state) and leakage or overflow points along the downstream faces of all three dams, including spillways. Methods should include visual surveys (on foot, from a boat, or snorkeling) and trapping using small mesh (< 1/8"-clear opening) baited eel pots. Visual surveys should be performed once per week, at night, preferentially during precipitation events. Trap sets should be performed once per week, with an overnight soak time. Recorded data should include location, observation of eels (presence, absence, relative numbers, relative sizes, behaviors, time/date of observation), and survey method.

2. Objective 2: Trap/Pass Collections

Areas identified from Systematic Surveys as having significant number of eels present should be targeted as potential areas for permanent eel trap/passes, and should be initially assessed using temporary/portable trap passes. At a minimum (regardless of survey results), temporary trap passes should be installed at stilling basins and/or lower sections of fishways supplied with minimal attraction flow (0.5-1.0 cfs) during dewatered conditions at all three projects, as these locations may be supplemented with additional attraction flow and have high potential for being concentration points for upstream migrant eels. Similarly, traps should also be placed at spillway or bypass channel locations where eels have a potential to climb wetted (e.g., via leakage) flow zones, at the highest points to which eels are able to climb, or where otherwise feasible. Temporary trap/passes should be purpose-designed and built for each location, and operated throughout the eel upstream migratory season (~1 May to 15 October, or when river temperatures exceed 10°C). Ramp-type traps with supplementary attraction flow are preferred temporary trap/pass designs. Traps should operate daily, with catches quantified every two to three (2-3) days. Recorded data should include location, trapping interval, absolute numbers of eels trapped, relative eel sizes, and hydraulic and environmental conditions during the trapping period.

All collected eels from surveys should be released at their point of capture; those eels collected from trap/pass collections should be transported to and released into the headponds upstream of where they were collected.

These methodologies are consistent with accepted practice.

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

The level of cost and effort for the survey component of the study would be low for each individual project (moderate for all three projects combined); a minimal number of personnel may be able to conduct the weekly surveys. The trap/pass component would require low to moderate cost and effort. We estimate $40,000 per project to conduct this study.

The Service is not aware of any previously conducted or ongoing studies related to upstream eel passage. The Applicant did not propose any studies to meet this need in the PADs.

REFERENCES

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar and B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department. Waterbury, Vermont. http://www.vtfishandwildlife.com/ swg_cwcs_report.cfm. (Accessed September 10, 2012).

TransCanada Study Request #10

Evaluation of Timing of Downstream Migratory Movements of American Eels on the Mainstem Connecticut River

(Turners Falls, P-1889; Northfield Mountain, P-2485; Bellows Falls, P-1855; Wilder, P-1892; Vernon, P-1904)

Goals and Objectives

The goal of this study is to better understand migration timing of adult, silver-phase American eels in relationship to environmental factors and operations of mainstem hydropower projects on the Connecticut River.

The objective of this study is:

Quantify and characterize the general migratory timing and presence of adult, silver-phase American eels in the Connecticut River relative to environmental factors and operations of mainstem river hydroelectric projects.

Resource Management Goals

The Atlantic States Marine Fisheries Commission (ASMFC) has developed two documents related to the management of American eel:

1. Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.
2. Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

Objectives of the management plan include: (1) protect and enhance American eel abundance in all watersheds where eel now occur; and (2) where practical, restore American eel to those waters where they had historical abundance, but may now be absent, by providing access to inland waters for glass eel, elvers, and yellow eel, and adequate escapement to the ocean for pre-spawning adult eel.

Addendum II contains specific recommendations for improving upstream and downstream passage of American eel, including requesting that member states and jurisdictions seek special consideration for American eel in the Federal Energy Regulatory Commission relicensing process.

In addition, the Connecticut River Atlantic Salmon Commission (CRASC) developed A Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin in 2005. The goal of the plan is "to protect and enhance the abundance of the American eel resource to ensure its continued role in the Connecticut River Basin ecosystem…" Management objectives in the plan include the following:

1. protect and enhance eel populations where they currently exist;
2. where practical, restore populations to waters where they had historical abundance;
3. provide effective upstream and downstream fish passage around dams and other barriers within the species' range in the basin; and
4. comply with all requirements of the Fishery Management Plan of the ASMFC.

Based on these plans, the U.S. Fish and Wildlife Service (Service) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the projects.

Specific to downstream passage of American eel, the Service's goals are:

1. Minimize current and potential negative project operation effects that could hinder management goals and objectives.
2. Minimize project-related sources of downstream passage delay, injury, stress, and mortality in order to maximize the number of silver eels migrating to the spawning grounds.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

Public Interest

The requester is a resource agency.

Existing Information

Data on timing of downstream migratory movements and rates of American eels in the mainstem Connecticut River are sparse and relatively incomplete. Preliminary data on the presence of "eel-sized" acoustic targets have been collected (Haro *et al.* 1999) within the Turners Falls Project's Cabot Station forebay that were somewhat confirmed by video monitoring at the Cabot Station downstream fish bypass; however, these were short-term studies, with acoustic monitoring only performed from 17 September to 5 October and video monitoring only conducted between 18 September to 22 October.

Some daily monitoring of the downstream bypass at the Holyoke Dam (canal louver array) was performed in 2004 and 2005 (Kleinschmidt, Inc. 2005, 2006, Normandeau Associates 2007); these studies also were of relatively short duration (spanning from October 5 to November 10 in 2004 and September 9 to November 11 in 2005) and the sampler was only operated at night.

To date, no other directed studies of eel migratory movements have been conducted at any location on the Connecticut River mainstem. This information gap needs to be filled, as it relates directly to when downstream passage and protection measures need to be operated.

We also note that within the past seven years, the Service has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005, the Service issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability (CESAR). On September 29, 2011, the Service issued a substantial 90-day finding and initiated a 12-month status review. The Service is still accepting new American eel information for the ongoing status review. The Service also is currently in settlement negotiations with CESAR on their legal complaint that the Service failed to complete the 12-month finding within the statutory timeframe. Although the date for completion of the Service's 12-month finding on the latest petition is uncertain, it is likely that it will be made before any new licenses are issued for the projects.

Nexus to Project Operations and Effects

The timing of downstream migration of adult eels is poorly defined for the Connecticut River; therefore, the general effects of hydroelectric project operations on eel survival to the ocean are unknown. Although separate study requests have been submitted to address project-specific downstream passage route selection, delays, and mortality of eels, general characteristics of river flow and environmental conditions may have significant relationships with project operation and eel migratory success and survival. For example, eels may tend to move immediately before or during periods of significant precipitation (or consequently river flow), times at which projects may be generating at maximum capacity or spilling, which may (or may not) present a higher passage risk to eels. Conversely, periods of low flow may be associated with a significant proportion of total river flow passing through turbine units, which present additional (or different) passage risk to eels. If discrete conditions which promote eel downstream migration are known, it may be possible to take actions with respect to project operations which reduce or minimize passage risk; i.e., operation of a bypass, reduction of intake approach velocities, directed spillage through a "safe" route, etc. These studies should provide baseline information on river-specific downstream migration to predict when silver-phase eels are expected to be migrating in the mainstem Connecticut River, from which project operations could be modified to minimize passage risks.

The studies are proposed for a single or multiple sites; the results will be relevant to all sites on the Connecticut River mainstem.

Methodology Consistent with Accepted Practice

Quantification of downstream movements of American eels in river systems requires systematic sampling of migrants throughout the migratory season. This can be accomplished with traditional active trapping methods; i.e., fyke or stow net sampling, weirs, or eel racks, but these methods are technically challenging on larger mainstem rivers, due to the scale of flows that need to be sampled, difficulties in operation throughout all flow conditions, and high debris loading during fall flows. Passive monitoring of migrant eels using hydroacoustic methods offers an alternative to active trapping. However, this form of passive monitoring requires verification of potential acoustic targets with some level of active (collection) or visual (traditional optical or acoustic video) sampling.

Two potential locations offer opportunities to conduct simultaneous passive and active sampling: the Cabot Station (Turners Falls Project) canal/forebay and the Holyoke Dam forebay and canal louver/bypass system. Each location possesses a route of downstream passage which conducts a significant proportion of river flow (Cabot canal and Holyoke forebay or canal), and each has a proximal bypass equipped with a sampler so that fish can be concentrated/collected from the passage route and identified to species. Project operations do influence the relative proportion of flow (and thus numbers of downstream migrant eels) in each passage route, so numbers of eels sampled in each route represent only a proportion of the total number of eels migrating downstream within the entire river. Because the absolute proportion of eels using a specific route at any one time is unknown, numbers of eels quantified within a route must serve as a relative index of the degree of migratory movement.

This study shall quantify eel movements in either one, or preferably both, locations for two consecutive years (since environmental conditions strongly influence migratory timing of eels, which can vary significantly from year to year) (Haro 2003). Eels will be quantified using methods similar to Haro *et al.* (1999), by continuously monitoring a fixed location at the projects with hydroacoustics. Because eels tend to concentrate in areas of dominant flow (Brown *et al.* 2009; EPRI 2001), the zone to be monitored should pass a dominant proportion of project flow throughout most periods of operation (i.e., forebay intake area). Hydroacoustic monitoring shall encompass the entire potential migratory season, beginning in mid-August and ending in mid-December, and shall operate 24 hours per day. Data will be recorded for later processing and archiving.

Systematic active quantification of eels at downstream bypass samplers shall be performed simultaneously with passive hydroacoustic monitoring, to verify presence of eels and relative abundance of eel-sized hydroacoustic targets from the hydroacoustic data. Although daily operation of the bypass sampler could be performed, a more comprehensive technique is to monitor eels entering the bypass with an acoustic camera (i.e., DIDSON, BlueView, etc.). The acoustic camera will afford positive visual identification of eels as they enter the bypass, which is a concentration point for migrating eels. Acoustic camera monitoring will also allow monitoring to be performed 24 hours a day, and will be relatively unaffected by water turbidity (which influences effectiveness of traditional optical video monitoring). The acoustic camera system will be operated during the same time period as acoustic monitoring, and images will be recorded for later processing and archiving.

Data analyses of hydroacoustic, acoustic camera, bypass sampling, and environmental/ operational data will follow standard methodology.

Project operation (flows, levels, gate openings, number of units operating and operation level) and environmental conditions (river flow, temperature, turbidity, air temperature, precipitation) will be monitored regularly (hourly measurements if possible) throughout the duration of the studies.

These methodologies are consistent with accepted practice.

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

The level of cost and effort for the downstream migrant eel migratory timing study would be moderate, given the level of cost for instrumentation, deployment, and data review/analysis. Cost is estimated at $50,000 per year for the study.

The Applicant did not propose any studies to meet this need in the PAD.

REFERENCES

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TransCanada Study Request #11

Downstream American Eel Passage Assessment at the Vernon, Bellows Falls, and Wilder Projects

(Bellows Falls, P-1855; Wilder, P-1892; Vernon, P-1904)

Goals and Objectives

The goal of this study is to determine the impact of three hydroelectric projects on the outmigration of silver eels in the Connecticut River. Entrainment at the conventional turbines at the Vernon, Bellows Falls, and Wilder projects can result in mortality or injury. It is important to understand the passage routes at each project and the potential for delay, injury, and mortality to assess alternative management options to increase survival.

The objectives of this study are:

1. Quantify the movement rates (including delays) and relative proportion of eels passing via various routes at the projects (i.e., through the turbines, through the downstream bypasses; spilled at the dams, etc.).
2. Evaluate instantaneous and latent mortality and injury of eels passed via each potential route.

Resource Management Goals

The Atlantic States Marine Fisheries Commission (ASMFC) has developed two documents related to the management of American eel:

1. Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.
2. Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

Objectives of the management plan include: (1) protect and enhance American eel abundance in all watersheds where eel now occur; and (2) where practical, restore American eel to those waters where they had historical abundance but may now be absent by providing access to inland waters for glass eel, elvers, and yellow eel, and adequate escapement to the ocean for pre-spawning adult eel.

Addendum II contains specific recommendations for improving upstream and downstream passage of American eel, including requesting that member states and jurisdictions seek special consideration for American eel in the Federal Energy Regulatory Commission relicensing process.

In addition, the Connecticut River Atlantic Salmon Commission (CRASC) developed A Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin in 2005. The goal of the plan is "to protect and enhance the abundance of the American eel resource to ensure its continued role in the Connecticut River Basin ecosystem..." Management objectives in the plan include the following:

1. protect and enhance eel populations where they currently exist;
2. where practical, restore populations to waters where they had historical abundance;
3. provide effective upstream and downstream fish passage around dams and other barriers within the species' range in the basin; and
4. comply with all requirements of the Fishery Management Plan of the ASMFC.

Based on these plans, the U.S. Fish and Wildlife Service (Service) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the projects.

Specific to downstream passage of American eel, the Service's goals are:

1. Minimize current and potential negative project operation effects that could hinder management goals and objectives.
2. Minimize project-related sources of downstream passage delay, injury, stress, and mortality in order to maximize the number of silver eels migrating to the spawning grounds.

The American eel (*Anguilla rostrata*) is also one of New Hampshire and Vermont's Species of Greatest Conservation Need (SGCN). The status for conservation need in Vermont is listed as high priority (Kart *et al.* 2005), and the species is listed as "vulnerable" in New Hampshire. As identified in Vermont's Wildlife Action Plan (Kart *et al.* 2005), threats to the species include the construction of large dams on rivers which obstruct juvenile fish access to critical rearing habitats, as well as mortality associated with passing through hydroelectric facilities' turbines during their outmigration to sea.

As outlined in Vermont's Wildlife Action Plan (Kart *et al.* 2005), research and monitoring needs for this SGCN include determining their distribution and abundance, as the contribution of eels in northern regions to overall stock is unknown. One of the conservation strategies for this species is to support efforts to enhance access of American eels to Vermont waters by eliminating or minimizing impacts of dams and other obstructions along the Richelieu, St. Lawrence, and Connecticut Rivers.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

Public Interest

The requester is a resource agency.

Existing Information

The PAD contains information on the biology and life history of the American eel. It also summarizes eel collection data within the Vernon and Bellows Falls project areas. Eels have been collected both upstream and downstream of the Vernon Project and also have been counted passing the upstream anadromous fish ladder. Eels also have been documented upstream of the Bellows Falls and Wilder projects.

To date, no directed studies of eel entrainment or mortality have been conducted at any of the projects. These information gaps need to be filled so resource agencies can assess the relative and cumulative impact of project operations on outmigrating eels and develop adequate passage and protection measures to meet management goals and objectives.

We also note that within the past seven years, the Service has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005, the Service issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability (CESAR). On September 29, 2011, the Service issued a substantial 90-day finding and initiated a 12-month status review. The Service is still accepting new American eel information for the ongoing status review. The Service also is currently in settlement negotiations with CESAR on their legal complaint that the Service failed to complete the 12-month finding within the statutory timeframe. Although the date for completion of the Service's 12-month finding on the latest petition is uncertain, it is likely that it will be made before any new licenses are issued for the projects.

Nexus to Project Operations and Effects

The Vernon, Bellows Falls, and Wilder projects operate as peaking facilities, except during periods when inflow exceeds the hydraulic capacities of the stations. Silver eels outmigrate during the mid-summer through late fall, a time of year when flows are generally within the operating capacities of the stations. Therefore, the projects would be expected to spill infrequently during the silver eel outmigration.

The project configurations present problems with respect to providing safe, timely and effective passage for outmigrating eels. The intakes likely are deep and, while no specification for the trashracks were provided in the PAD, it is unlikely that they would prevent impingement and/or entrainment of eels. Existing anadromous downstream passage facilities at the projects also would not be expected to be effective for eels; the target anadromous species are surface-oriented, while eels tend to move much deeper in the water column. Eels are known to occur upstream of the dams; therefore, it is neçessary to understand how eels move through the projects and the level of injury or mortality caused by entrainment through the projects' turbines.

Methodology Consistent with Accepted Practice

In order to understand the movements of outmigrating silver eels as they relate to operations at the Vernon, Bellows Falls, and Wilder projects, radio telemetry technology should be utilized. Radio telemetry is an accepted technology that has been used for a number of studies associated with hydropower projects, including at the Muddy Run Project (FERC No. 2355).

Studies should be designed to investigate route selection (i.e., entrainment vs. spill) independently from estimation of mortality/injury, because these metrics require different telemetric methodologies. Studies also will likely benefit from data collected over both study years (especially route selection studies, which may be more significantly affected by environmental conditions during a given season than mortality/injury studies). It is also envisioned that results from route selection studies can guide design of turbine mortality studies. Therefore, it is proposed, at a minimum, that route selection studies be conducted in multiple years, but mortality/injury studies may be conducted after the first year of route selection studies has been completed.

1. Objective 1: Route Selection

This study will involve systematic releases of radio-tagged silver phase eels at strategic points above areas of interest, to assess general routes of passage (i.e., via spill, bypass, or turbines). Active downstream migrants should be collected within-basin if possible (i.e., Cabot or Holyoke bypass samplers), but fish sourced from out of basin may be acceptable to meet sample size demands. Experimental fish must meet morphometric (e.g., eye diameter relative to body size) criteria to ensure they are migrant silver phase. Collections should be made within the migratory season (late August to mid-October), and eels should be tagged and released within 21 days after capture, but preferably within seven days (particularly if the test eels are from out-of-basin).

All telemetered eels will be radio and passive integrated transponder (PIT) tagged. PIT antennas will be installed at bypasses at Vernon and Bellows Falls and monitored continuously to verify passage of eels via bypass channels.

Vernon Project Route Selection Study:

A minimum number of 50 telemetered eels (e.g., five separate groups of approximately 10 eels each) will be required to maximize the data return. Tagged eels should be released at least 5 km upstream of the Vernon Project. Groups of eels should be released during spill and non-spill periods, if possible. Telemetry receivers and antennas should be located to assess passage via the following potential routes: Vernon spillway; fishway attraction water intake (if operational); Vernon downstream bypasses; and Vernon station turbines.

Eels from the Bellows Falls route studies migrating to the Vernon Dam may be used to supplement (but not serve in lieu of) these release groups.

Bellows Falls Dam Route Selection Study:

A minimum number of 50 telemetered eels (e.g., five separate groups of approximately 10 eels each) will be required to maximize the data return. Groups of eels should be released during spill (if any) and non-spill and during periods of low, moderate, and high generation conditions, if possible. Tagged eels should be released at least 5 km upstream of the Bellows Falls Dam. If significant spillage occurs during releases, up to 50 additional eels should be released in the upper canal and allowed to volitionally descend through the canal to assure that sufficient number of eels are exposed to canal and powerhouse intake conditions.

Telemetry receivers and antennas should be located upstream and downstream of the spillway, at the canal entrance, within the canal, in the downstream fish bypass entrance turbine intakes, and station tailrace. These locations will permit assessment of passage via the following potential routes: the power canal; spillway; downstream fish bypass; station turbines; and upstream fishway attraction water intake. The attraction water intake should be operated during the study to assess its use by eels, as it may be operated in the future for riverine and/or eel passage, as addressed in the resident fish passage study request. Eels from the Wilder route study migrating to the Bellow Falls Project may be used to supplement (but not serve in lieu of) these release groups.

Wilder Project Route Selection Study:

A minimum number of 50 telemetered eels (e.g., five separate groups of approximately 10 eels each) should be required to maximize the data return. Tagged eels should be released at least 5 km upstream of the Wilder Project. Groups of eels should be released during spill and non-spill periods if possible. Telemetry receivers and antennas should be located to assess passage via the following potential routes: Wilder spillway; fishway attraction water intake (if operational); Wilder downstream bypasses; and Wilder station turbines.

Mobile tracking (i.e., via boat) in river reaches between release sites and several km downstream of Vernon Station will be performed at regular intervals during and after releases to confirm routes and fates of passed fish, or fish lost to follow-up.

Movement rates (time between release and detection at radio antenna locations, and between radio antenna locations) of eels passing the projects by various routes will also be quantified.

The route selection portion of this study should occur in both study years.

2. Objective 2: Spill, Bypass, and Turbine Mortality/Injury Studies

Spill, bypass, and turbine mortality will be assessed using a radio-telemetric balloon tag method. A minimum number of 50 tagged eels (e.g., five separate groups of approximately 10 eels each) will be required at each location (dam spillways, downstream bypasses, and station turbines) to maximize the data return.

For spill mortality sites (dam spillways and downstream bypasses), tagged eels will be injected or released into spill flow at points where water velocity exceeds 10 ft/sec to minimize the possibility of eels swimming upstream into the headpond or canal. Passed balloon-tagged eels will be recovered below areas of spill and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged eels will be censored from the data.

For turbine mortality sites (Vernon, Bellows Falls, and Wilder stations), tagged eels will be injected into intakes of units operating at or near full generation at points where intake water velocity exceeds 10 ft/sec to minimize the possibility of eels swimming back upstream through the intakes. Passed balloon-tagged eels will be recovered in the tailrace and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged eels will be censored from the data.

If the balloon-tag mortality component of the study occurs in study year one, all possible route selection sites would need to be evaluated. If the balloon-tag mortality component of the study occurs in study year two, results from the route selection study (year one) could be used to inform which sites need to be evaluated for mortality. Eels recovered from balloon tag studies should not be used for route selection studies.

Data analyses of route selection and turbine mortality (instantaneous and latent) will follow standard methodology.

Project operation (flows, levels, gate openings, number of units operating and operation level) and environmental conditions (river flow, temperature, turbidity, air temperature, precipitation) will be monitored regularly (hourly measurements if possible) throughout the duration of the studies.

These methodologies are consistent with accepted practice.

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

The level of cost and effort for the downstream eel passage study would be moderate to high; silver eels would need to be collected, tagged, and released in several locations over the course of the migration season. Antennas and receivers would need to be installed at the intakes of all stations, as well as at the dam spillways and station bypasses, and monitored regularly. Data would need to be retrieved periodically, then analyzed. A multi-site route selection study conducted by the USGS Conte Lab on the Shetucket River in Connecticut cost approximately $75,000 for the first year of study. Costs are estimated at $100,000 per year for the route selection studies and $75,000 per year for the spill, bypass, and turbine mortality/injury studies for each project.

The Applicant did not propose any studies to meet this need in the PAD.

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Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar and B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department. Waterbury, Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm. (Accessed September 10, 2012).

TransCanada Study Request #12

Assessment of Adult Sea Lamprey (*Petromyzon marinus)* Spawning within the Wilder, Bellows Falls, and Vernon Project Areas

(Bellows Falls, P-1855; Wilder, P-1892; Vernon, P-1904)

Perform a study to investigate potential impacts of the Wilder, Bellows Falls and Vernon project operations on sea lamprey spawning success.

Goals and Objectives

1. Identify areas within the Wilder, Bellows Falls, and Vernon project areas where suitable spawning habitat exists for sea lamprey.

2. Conduct a telemetry study of sea lamprey during their upstream migration period in the spring, focusing on areas of suitable spawning habitat, and areas of known spawning.

3. Conduct spawning ground surveys to observe the utilization of this habitat for spawning purposes, and hence, confirm suitability.

4. Obtain data on redd characteristics, including location, size, substrate, depth and velocity.

5. Determine if the operations at the Wilder, Bellows Falls and Vernon projects are adversely affecting these spawning areas (i.e., if flow alterations are causing dewatering and/or scouring of sea lamprey redds).

6. If it is determined that the operations of the projects are adversely affecting the spawning success of sea lamprey, identify operational regimes that will reduce and minimize impacts to sea lamprey spawning habitat and spawning success.

Resource Management Goals

The U.S. Fish and Wildilfe Service (Service) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the projects.

Specific to aquatic resources, the Service's goals are:

1. Protect, enhance, or restore diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.

2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by project operations.
3. Minimize current and potential negative project operation effects on water quality and aquatic habitat.

The sea lamprey (*Petromyzon marinus*), within the Connecticut River drainage, is one of New Hampshire and Vermont's Species of Greatest Conservation Need (SGCN). The conservation status of sea lamprey in New Hampshire is listed as "vulnerable." One of the threats identified in Vermont's Wildlife Action Plan (VWAP) (Kart *et al.* 2005) is degraded spawning habitat, which is second to habitat fragmentation.

As outlined in the VWAP, research and monitoring needs for SGCN include monitoring and assessing populations and habitats for current conditions and future changes, and identifying and monitoring problems for species and their habitats. One of the conservation strategies identified in the VWAP is protecting and restoring aquatic and riparian habitats through improved water quality; flow, water level and temperature regimes; sediment reduction; establishment of streamside buffers; and suitable aquatic habitat structure, diversity and complexity.

In support of conservation strategies and research needs listed above, potential impacts that the Wilder, Bellows Falls, and Vernon projects have on sea lamprey spawning need to be evaluated. Results of the study may be used to develop flow-related license requirements and/or other mitigation measures that will optimize lamprey spawning habitat and spawning success.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

Public Interest

The requestor is a natural resource agency.

Existing Information

It is known that sea lamprey spawn in the Connecticut River main stem at least as far upstream as Wilder Dam, as well as tributary waters including the West, Williams, Black and White rivers (Kart *et al.* 2005).

The PAD discusses sea lamprey distribution as: "FWS (2012) lists the current upstream extent of sea lamprey range as Bellows Falls Dam, noting, however, that reproduction has been documented as far north as the White River, Vermont, in the Wilder Project area. In certain years hundreds to thousands of sea lamprey have been recorded passing upstream of Bellow Falls Dam, and in at least one year (2008), sea lamprey were documented passing upstream via the

Wilder Dam fish ladder. In 2008 surveys, Yoder *et al.* (2009) documented sea lamprey just downstream of the confluence of the White River."

In 2012, a total of 99 sea lamprey were observed passing the Bellows Falls Dam, and a total of 696 sea lamprey were observed passing the Vernon Dam.

To date, no studies have been conducted that aim to identify spawning habitat and spawning activity of sea lamprey within in the Wilder, Bellows Falls, and Vernon project areas and to identify whether project operations are affecting these activities.

Nexus to Project Operations and Effects

The operation of the Wilder, Bellows Falls and Vernon projects, including minimum flows and large and rapid changes in flow releases from the dam, have the potential to cause direct adverse effects on spawning habitat and spawning activity downstream of the dam. If adult sea lampreys are actively spawning in the project area, it is important to assess whether operations of the projects are having any adverse effects (i.e., dewatering and scouring) on these activities.

Methodology Consistent with Accepted Practice

Although a relatively new practice, the tagging and tracking of adult Pacific lamprey to determine final destination has been successfully conducted in the Columbia River (Noyes *et al.* 2011). Similarly, from 2005-2009, radio telemetry was used to determine adult lamprey overwintering and spawning habitats, and spawn timing in the lower Deschutes River Subbasin (Fox *et al.* 2009). These techniques should be applicable to use with sea lamprey.

In Vermont, factors affecting sea lamprey survival were examined (Smith and Marsden 2009). It was found that predation, water currents, and displacement of eggs from the nest played a role in survival.

As part of the Wells Hydroelectric project (FERC No. 2149), Pacific lamprey spawning ground surveys were conducted to determine project effects on spawning success (Le and Kreiter 2008).

In 2010, redd surveys were completed in Shitike and Beaver Creeks to identify recent redds for placement of an experimental redd cap. The purpose of capping lamprey redds was to enumerate emerging larvae and to document timing of emergence with respect to estimated date of redd construction and water temperature (Fox *et al.* 2010). Therefore, to determine project effects on the spawning success of sea lamprey, study methods should follow those described in Fox *et al.* (2010).

Level of Effort/Cost, and Why Alternative Studies will not suffice

The level of effort and costs for this study will be based on the final study plan, developed in consultation with the resource agencies. Variables that affect study cost and effort include the number of lamprey tagged and the number of nests and amount of suitable habitat found. The Applicant did not propose any alternative studies in its PAD to address this specific issue.

REFERENCES

Fox, M. J.C. Graham and S. Frank. 2009. Determining Adult Pacific Lamprey Abundance and Spawning Habitat in the Lower Dechutes River Sub-Basin, Oregon. Department of Natural Resources Confederated Tribes of the Warm Springs Reservation, Oregon.

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Le, Bao and S. Kreiter. 2008. An assessment of Adult Pacific Lamprey Spawning within the Wells Project. Wells Hydroelectric Project No. 2149.

Noyes, C.J., C.C. Caudill, T.S. Clabough, D.C. Joosten, E.L. Johnson, M.L. Keefer and G.P. Naughton. 2011. Adult Pacific lamprey migration behavior and escapement in the Bonneville Reservoir and Lower Columbia River monitored using the juvenile salmonid acoustic telemetry system (JSATS). Technical Report 2012-4-Draft.

Smith, S. J. and J. E. Marsden. 2009. Factors Affecting Sea Lamprey Egg Survival. North American Journal of Fisheries Management 29:859–868.

Yoder, C.O., L.E. Hersha and B. Appel. 2009. Fish assemblage and habitat assessment of the Upper Connecticut River: preliminary results and data presentation. Final Project Report to: U.S. EPA, Region 1, Boston, MA. Center for Applied Bioassessment and Biocriteria. Midwest Biodiversity Institute. Columbus, OH.

TransCanada Study Request #13

Effects of the Wilder and Bellows Falls Projects on the Dwarf Wedgemussel (*Alasmidonta heterodon*)

(Bellows Falls, P-1855; Wilder, P-1892)

Goals and Objectives

It has been well documented that the damming of rivers can have detrimental impacts on the mussel communities that inhabit areas both upstream and downstream of dams (Watters 1999; Layzer *et. al.* 1993; Moog 1993). The goal of this study is to evaluate the effects that the Wilder and Bellows Falls hydroelectric projects have on populations of the federally endangered dwarf wedgemussel (*Alasmidonta heterodon*). In addition, the results of the study can be used to develop measures to minimize adverse impacts to the dwarf wedgemussel in the future. The specific objectives of the study are as follows:

1. conduct an initial survey of the free-flowing stretch of the Connecticut River from the Wilder Dam to the upstream end of the Bellows Falls impoundment to determine the distribution of the dwarf wedgemussel in this reach;
2. determine the best sites for intensive quantitative sampling of mussel communities, with emphasis on the dwarf wedgemussel. Data will be collected to estimate density (mussels per unit area) and age class structure for all species;
3. lay the groundwork for a long-term monitoring program;
4. document instream behavior of mussels during varying flow conditions; and
5. determine how availability and persistence of dwarf wedgemussel habitat changes with water level and flow fluctuations.

Resource Management Goals

The dwarf wedgemussel is a federally endangered species. As such, this study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures and protection, mitigation, and enhancement measures for the species pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq*.).

It is the goal of the U. S. Fish and Wildlife Service to recover the dwarf wedgemussel so that it can be removed from the endangered species list in the future. According to the Recovery Plan (USFWS 1993), the Connecticut River dwarf wedgemussel population is one that must be demonstrated to be viable before the species can be downlisted to threatened. The upper Connecticut River metapopulation is likely the largest remaining population in the world (USFWS 2007), therefore its protection is essential to the recovery of the species as a whole.

Public Interest

The requestor is a natural resource agency.

Existing Information

In 2011, Biodrawversity, LLC conducted a freshwater mussel survey throughout the Vernon, Bellows Falls, and Wilder project areas (Biodrawversity and LBG 2012). This survey was semi-quantitative (i.e., timed searches were used) and the main goal was to assess the distribution, abundance, demographics, and habitat of the dwarf wedgemussel in the project areas. Dwarf wedgemussel were found in the Wilder impoundment (all within a 14-mile stretch of the river beginning 27 miles upstream of the Wilder Dam) and Bellows Falls impoundment (located sporadically in the upper 17 miles of the impoundment); none were found in the Vernon project-affected area. These results corroborate the results of other studies performed in the past in these areas (Nedeau 2006a; Nedeau 2006b).

The 2011 survey did not include the 17-mile free-flowing stretch of the Connecticut River downstream of Wilder Dam. The dwarf wedgemussel has, in the past, been found within this river reach, although overall there has been limited survey work in the area. A better understanding of the distribution and abundance of the dwarf wedgemussel in this stretch of the river is required before an evaluation of how the dam affects this species can be made. This need is represented in Objective 1.

Since the 2011 survey was semi-quantitative, it cannot be used as a basis for determining population estimates or trends (Wicklow 2005). In fact, few if any of the past surveys performed in the project-affected areas have employed quantitative methodology. In addition, there is little quantitative information regarding the age class structure, and therefore recruitment, of the mussel communities in the area. In order to demonstrate that a dwarf wedgemussel population is viable according to the Dwarf Wedgemussel Recovery Plan (USFWS 1993), it must have a large and dense enough population to maintain genetic variability, and annual recruitment must be adequate to maintain a stable population. Thus, knowledge of population size and density as well as a better understanding of age class structure is a necessary step in determining the baseline status of dwarf wedgemussel populations. The 2011 survey and other surveys can be used to determine the best sites for implementing a monitoring program. This need is represented in Objective 2.

Once this baseline is established, it will be important to monitor the sites so that biologists can estimate and track changes to dwarf wedgemussel populations and/or evaluate any project-related population impacts. Therefore, there is a need to develop long-term monitoring plots that will be surveyed at regular intervals using methodology that is repeatable and yields quantitative, statistically valid results. This need is represented in Objective 3.

Flow conditions that result from dam operations may alter the behavior of individual dwarf wedgemussels or individuals of other species. Dam operations affect streamflow, temperature, and dissolved oxygen, and changes to these variables can often be rapid. It is not known how these rapid changes affect various aspects of a mussel's biology, including lure display, shell position (open/closed), siphoning rate, and vertical migration. This need is represented in Objective 4.

Dam operations can also affect the availability of habitat for mussels, and this availability can change quickly as water levels fluctuate under peaking operations. The persistence of habitat is a key element to the long-term success of sedentary lotic organisms such as the dwarf wedgemussel (Maloney *et al.* 2012), which is unable to quickly move in response to rapid changes in its environment and can thus become stranded in areas of unsuitable habitat; however, there is currently no information concerning the relation of project operations to habitat persistence within the Wilder and Bellows project-affected areas. This need is represented in Objective 5.

Nexus to Project Operations and Effects

The dwarf wedgemussel is known to occur within the Wilder and Bellows Falls project areas and operations of these two dams may affect the viability of this species in the Connecticut River. This study plan will allow for a better understanding of how sub-daily flow and water level fluctuations influence dwarf wedgemussel abundance, available habitat, and behavior. This information can be used to inform the development of license requirements that can ensure the continued existence of this species within the project-affected areas.

Additionally, a long-term monitoring program of important dwarf wedgemussel sites within the project areas is necessary to evaluate any project-related population and/or behavioral impacts that may occur. This information can be used to inform decision makers in the future.

Methodology Consistent with Accepted Practice

A survey of the 17-mile reach between the Bellows Falls impoundment and the Wilder Dam is the logical first step of the study plan, and this can be done in less than one field season. This may be treated as an extension of the Biodrawversity and LBG (2012) survey and the same semi-quantitative methodology may be used. Once completed, this survey will help fill in the knowledge gap that exists in the distribution of the dwarf wedgemussel within this reach of the Connecticut River. This proposed methodology corresponds to Objective 1.

Next, quantitative study plots should be established at sites throughout the two project-affected areas that are known to support the dwarf wedgemussel. Plots should be set up and surveyed using methodology that will allow for the estimation of population density and size. Smith *et al.* (2001) have developed such a methodology, which is also outlined in Strayer and Smith (2003). It is based on a double-sampling design (visual inspection of the substrate surface plus excavation of a random subset of quadrats) using 0.25 m^2 quadrats that are placed systematically with multiple random starts. This protocol has been used to monitor dwarf wedgemussel populations at two sites on the Ashuelot River in Keene, New Hampshire (Nedeau 2004). A number of other recent studies have also made use of this protocol for different species of mussels (Fulton *et al.* 2010; Crabtree and Smith 2009; Bradburn 2009).

Data to determine age class structure should also be collected at these selected sites. This would involve measuring the length and estimating the age (through external annuli counts) of each mussel sampled within a quadrat. Based on this information, an analysis of recruitment can be made. This field work and analysis was performed on the mussel community inhabiting the lower Osage River in Missouri as part of the relicensing process of the Osage Hydroelectric Project (FERC No. 459) (Ecological Specialists, Inc. 2003). The work done on the Osage can be used as a template for this study. Depending on how many plots are chosen, this phase of the study could take one or two field seasons. This proposed methodology corresponds to Objective 2.

The sites surveyed to meet Objective 2 should be resurveyed using the same methodology at regular intervals in the future so that any changes over time and/or over varied flow regimes can be evaluated. In addition, a mark-recapture pilot study should be initiated to evaluate the potential for using this methodology for long-term monitoring of dwarf wedgemussel abundance and survival. Mark-recapture methods provide statistically robust estimates of population parameters that are superior to simple count estimates in cases where it is not practicable to count all individuals in a population. Methods should be similar to those in Peterson *et al.* (2011), Meador *et al.* (2011), and Villella *et al.* (2004), but should focus on differences among sampled sites. Sites should be selected based on those sampled to meet Objective 2, but should also include sites outside of the project area to fully evaluate project effect and to account for any natural variability that may be independent of project effect.

A long-term mussel monitoring program was devised as part of the study plan for the relicensing of the Lake Blackshear Hydroelectric Project (FERC No. 659) on the Flint River in Georgia. According to the monitoring plan (Lake Blackshear Project 2009), three surveys will be conducted five years apart, beginning five years after issuance of the FERC license. Surveys will be quantitative (there is a qualitative aspect to the Lake Blackshear mussel monitoring plan that can be ignored) and will focus on evaluating changes in recruitment and population size of the purple bankclimber (*Elliptoideus sloatianus*), a federally listed species. A similar protocol should be used to monitor dwarf wedgemussel populations in the project-affected areas of the Connecticut River post-license, although the number of surveys and the time between surveys may require some research and discussion. This proposed methodology corresponds to Objective 3.

In order to investigate the effects that the hydropower projects have on mussel behavior, individual mussels should be observed as flow fluctuates as a result of dam operations. Researchers should measure changes in shell position (open/closed), siphoning rate, lure display, horizontal migration (movement across the substrate), and vertical migration (burrowing). Past studies have quantified changes in vertical migration due to flow fluctuations (Saha and Layzer 2008; DiMaio and Corkum 1997). This phase of the study will likely take two field seasons in order to maximize the number of behavioral observations so that any trends can be identified and evaluated. This proposed methodology corresponds to Objective 4.

At these same sites, an evaluation of flow fluctuations on dwarf wedgemussel habitat persistence should be conducted following methods similar to those of Maloney *et al.* (2012). This will include the development of a two-dimensional hydrodynamic model based on modeled depth, velocity, Froude number, shear velocity, and shear stress. This model will be used to quantify suitable dwarf wedgemussel habitat and its persistence over a range of flows, including flows typically experienced under peaking operations. These methods are being employed to evaluate persistence of dwarf wedgemussel habitat on the Delaware (Maloney *et al.* 2012) and

Susquehanna rivers (T. Moburg, The Nature Conservancy, personal communication). Depending on how many plots are chosen, this phase of the study could take one or two field seasons. This proposed methodology corresponds to Objective 5.

Level of Effort/Cost and Why Alternative Studies Will Not Suffice

The cost for collecting the data for this study is entirely dependent on the number of study sites selected, as well as how frequently surveys will be conducted as part of the long-term monitoring plan. The expected level of effort and anticipated costs will be comparable to those of similar Federal Energy Regulatory Commission relicensing projects of this size.

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TransCanada Study Request #14

Project Effects on Populations of Tessellated Darter, *Etheostoma olmstedi*
(Bellows Falls, P-1855; Wilder, P-1892; Vernon, P-1904)

Goals and Objectives

The goal of this study is to evaluate the effects of project operations on populations of the tessellated darter (*Etheostoma olmstedi*), a New Hampshire species of greatest conservation concern and known host species for the federally endangered dwarf wedgemussel (*Alasmidonta heterodon*). The specific objectives of the study are to:

1. determine the distribution and abundance of the tessellated darter within project-affected areas; and
2. determine the effects of project operations on the distribution and abundance of the tessellated darter.

Resource Management Goals

The U.S. Fish and Wildlife Service (Service) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the project.

Specific to aquatic resources, the Service's goals are:

1. Protect, enhance, or restore diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by project operations.
3. Minimize current and potential negative project operation effects on water quality and aquatic habitat.

The tessellated darter is one of only three fish species in the upper Connecticut River that serve as hosts for the glochidia of the federally endangered dwarf wedgemussel, the others being the slimy sculpin (*Cottus cognatus*) and the Atlantic salmon (*Salmo salar*) (Wicklow 2005). Tessellated darters may be the most important hosts for the dwarf wedgemussel in the upper Connecticut River for the following reasons:

1. The Service has decided to end its program of stocking hatchery-reared salmon in the Connecticut River basin and accordingly it is unlikely that salmon parr will be available as potential hosts.
2. The tessellated darter appears to be more widespread than the slimy sculpin in the Bellows Falls and Wilder project areas where the dwarf wedgemussel is known to exist. Yoder *et al.* (2009) found the darter in the project areas upstream and downstream of both dams, while the sculpin was not found in either project area.

It is the goal of the Service to recover the dwarf wedgemussel so that it can be removed from the endangered species list in the future. Populations in the upper Connecticut River are dependent on healthy tessellated darter populations, and therefore a better understanding of how dam operations affect the darter is crucial to the recovery of the dwarf wedgemussel.

A mission of both the New Hampshire Fish and Game Department and the Vermont Fish and Wildlife Department is to protect and conserve fish and wildlife and their habitats. Riverine fish species are an important component of the river's ecology. The tessellated darter is identified by New Hampshire as a Species of Greatest Concern.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

Public Interest

The requestor is a natural resource agency.

Existing Information

In the PADs for the Wilder, Bellows Falls, and Vernon projects, the Applicant acknowledges that the tessellated darter is one of the confirmed hosts of the dwarf wedgemussel. The PADs also identify the occurrence of the tessellated darter both upstream and downstream of each project. However, studies that specifically target small-bodied benthic species are lacking in project-affected areas. It is therefore likely that results of previous investigations are biased and underestimate true population size. An effective evaluation of project effects on a population will require robust, unbiased estimates of population parameters such as abundance or occupancy and similar estimates of population parameters under known conditions of low to no effect.

Existing literature indicates that tessellated darters may be found in a variety of habitats (Scott and Crossman 1979; Van Snik Gray and Stauffer 1999; Hartel *et al.* 2002; Van Snik Gray *et al.* 2005; Henry and Grossman 2008), but these habitats are not necessarily equal in their ability to support the population or its function as host to dwarf wedgemussel. We cannot be certain that habitat use infers preference, nor that habitat use will be consistent from basin to basin. Therefore, habitat use within project-affected areas should be evaluated, and should be evaluated in concert with population parameters. By estimating population parameters (e.g., abundance, occupancy, extinction/colonization) as functions of habitat, we may determine whether habitat contributes to any differences in populations and if so, what specific habitat is preferred for stable and persistent populations.

Nexus to Project Operations and Effects

Operations at the Wilder, Bellows Falls, and Vernon projects alter natural river flow and consequently cause changes in the availability of instream habitat on which the tessellated darter and other lotic species depend. Habitat for tessellated darters is directly related to project operations in terms of flow (water depth and velocity, and their timing, duration, frequency, and rate of change), as well as the interactions of flow with other habitat variables such as substrata, vegetation, and cover. Operations both upstream (changes to the reservoir) and downstream (changes to the flow regime) may affect habitat, and may consequently lead to changes in the distribution, abundance, and behavior of tessellated darters that could in turn potentially affect the federally endangered dwarf wedgemussel.

The information collected for this requested study will help determine whether project operations have a substantial effect on populations of tessellated darter, or whether population parameters are consistent with those of other populations in the region. If there is an effect of project operations on darter populations, study results will also permit identification of those habitat components related to operations that are most important for maintenance of stable and persistent populations of the tessellated darter. This will in turn provide information that will assist in the development of recommendations aimed at maintaining populations of the dwarf wedgemussel.

Methodology Consistent with Accepted Practice

Using an accepted and robust field sampling design (e.g., as described in Pollock *et al.* 2002 or MacKenzie *et al.* 2006) and accepted methods for collecting tessellated darters and other similar small-bodied fishes, conduct a field survey for tessellated darters within all project-affected areas from the headwaters of the Wilder pool downstream to the Vernon Dam, as well as in selected areas outside of the project-affected areas with known stable populations of tessellated darter and/or dwarf wedgemussel. Such a sampling design should include replicate samples for estimation of species detection probability. For each replicate sample, collect and record data that may be important for describing differences in populations of tessellated darter, such as presence or abundance of other species (e.g., dwarf wedgemussel, slimy sculpin [*Cottus cognatus*]), depth, velocity, water temperature, substrata, time of day, presence of cover, proportion of vegetation cover, size of individuals collected (juveniles may select different habitat; larger individuals may outcompete smaller individuals for preferred habitat), and other factors as determined by a qualified biologist. Include also as covariates any relevant flow characteristics (Zimmerman 2006) that may differ among sites.

Using methods as described by Kery *et al.* (2005), MacKenzie *et al.* (2006), or Wenger and Freeman (2008), determine whether population estimates of the tessellated darter are different in project-affected areas and, if so, which measured factors or flow characteristics are most important in describing these differences.

Level of Effort/Cost and Why Alternative Studies Will Not Suffice

The cost for collecting the data for this study is entirely dependent on the number of sites, number of sample replicates, and the extent of the covariate data that are measured, all of which should be determined during the development of the study plan in consultation with fishery agencies and other parties, and may be adjusted during the course of field sampling. In general, if a species is common and easily captured, few replicates and many sites produce the best estimates, whereas more replicates and fewer sites are preferable for rare species. In general, the more replicates added, the lower the errors in detection probability, and the more sites sampled, the lower the errors in population parameters. The number of people required in the field will be dependent on the sampling method that is selected, but should be at least two individuals. Provided the collected data are of high quality, analysis and synthesis should take at most 5-10 days.

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TransCanada Study Request #15

Determine the Fish Assemblage in Vernon, Bellows Falls and Wilder Project-Affected Areas

(Bellows Falls, P-1855; Wilder, P-1892; Vernon, P-1904)

Goals and Objectives

The goal of this study request is to determine the occurrence, distribution, and relative abundance of fish species present in the project-affected areas of the Vernon, Bellows Falls and Wilder projects, which potentially include Species of Greatest Conservation Need (SGCN) for both New Hampshire and Vermont.

Specific objectives include:

1. Document fish species occurrence, distribution and abundance within the project-affected areas along spatial and temporal gradients.
2. Compare historical records of fish species occurrence in the project-affected areas to results of this study.

Resource Management Goals

The U.S. Fish and Wildlife Service (Service) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the projects.

Specific to aquatic resources, the Service's goals are:

1. Protect, enhance, or restore, diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the areas impacted by project operations.
3. Minimize current and potential negative project operation effects on water quality and aquatic habitat.

A mission of both the New Hampshire Fish and Game Department and the Vermont Fish and Wildlife Department is to protect and conserve fish and their habitats. Riverine fish species are an important component of the Connecticut River's ecology and are the basis for the sport fishery. Furthermore, several of the states' SGCN have been documented in the project-affected areas.

Determining species occurrence, distribution and abundance will help address research and monitoring needs for species whose populations are poorly known. For example, as outlined in Vermont's Wildlife Action Plan (Kart *et al.*2005), research and monitoring needs for SGCN include monitoring and assessing populations and habitats for current conditions and future changes, and identifying and monitoring problems for species and their habitats.

A study that aims to provide a comprehensive investigation that documents which fish species are utilizing the project-affected areas in relation to spatial, temporal and environmental gradients (i.e., temperature, dissolved oxygen, pH, turbidity) will allow for a fuller understanding and examination of potential impacts that the Vernon, Bellows Falls and Wilder project operations have on the species that reside there. As noted below, there is little information concerning riverine fish in the project-affected areas related to this study request.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

Public Interest

The requestor is a natural resource agency.

Existing Information

A thorough and comprehensive assessment of the fish assemblage present in the project-affected areas of the Bellows Falls and Wilder projects is lacking. The PAD for the Bellows Falls Project acknowledges that "Little comprehensive information is available regarding characterization of the fish community in relation to the Project." The PAD for the Wilder Project states "No targeted studies have been conducted to characterize the fish community in relation to the Project."

The most relevant fish study related to the Bellows Falls and Wilder project-affected areas is a Connecticut River electrofishing survey conducted in 2008 (Yoder *et al.* 2009). While some sampling was conducted in both project-affected areas during the 2008 survey, this survey did not have the same goals and objectives as those outlined above. Additionally, both the Bellows Falls and Wilder PADs acknowledged that fish species assemblage data are limited and that the synthesized data may not be a full representation of species occurrence in the project-affected areas. Although fish data have been collected by Vermont Yankee for many years in the Vernon Dam project-affected area, objectives and methodology for those fish surveys differ from those stated here, and gear types were generally limited to boat electrofishing, which may not be suitable for properly assessing all species present in the project-affected areas. It is unknown if other species may inhabit or utilize aquatic habitats in the project areas that to this date have not been documented by previous surveys. It follows that without more information on the fish community in the project-affected areas, project impacts on fish species are also unknown.

Nexus to Project Operations and Effects

Project operations have the potential to directly impact fish species life history requirements, biological interactions, and habitat quantity and quality. For example, headpond and tailwater water level fluctuations could dewater important spawning areas or change available habitat, thus limiting productivity of important game fish species by direct impacts to their spawning success or indirectly by limiting the spawning success of forage fish species. Furthermore, several of New Hampshire and Vermont's SGCN have been documented in the project-affected area. Accordingly, a thorough understanding of the current fish assemblage structure and associated metrics is needed in order to examine any potential project-related impacts.

Methodology Consistent with Accepted Practice

An accepted and robust field sampling design (e.g., as described in Pollock *et al.* 2002 or MacKenzie *et al.* 2006) and accepted methods for collecting fish species likely to be present in the project-affected areas (Bonar *et al.* 2009) should be used to conduct field surveys. Randomly sampling multiple habitat types using a multi-gear approach will be required to ensure that all fish species present are sampled. The spatial scope of the study will be from the most upstream area influenced by the Wilder Dam to the most downstream area influenced by the Vernon Project. Sampling should occur at each selected site across multiple seasons (spring, summer, and fall). Digital photographs should be taken to avoid misidentifying certain species such as Cyprinids.

The sampling design should include replicate samples for estimation of species detection probability. Sample replicates may be gathered temporally, using different methods, by independent observers, or by randomly sampled spatial replicates (MacKenzie *et al.* 2006). For each replicate sample, data that may be important for describing variation in species occurrence and presence/absence should be collected and recorded, such as gear type, mesohabitat type, depth, velocity, flow, water temperature, substrate, time of day, day of year, presence of cover, proportion of vegetation cover, size of individuals collected (juveniles may select different habitat), and other factors as determined by a qualified biologist. Species detection, occurrence, and/or abundance as related to these parameters should be estimated using methods as described by Kery *et al.* (2005), MacKenzie *et al.* (2006), Wenger and Freeman (2008), or Zipkin *et al.* (2010).

Based on first year study results, specific studies examining impacts of project operations on specific fish species may be requested. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year proves to be atypical (outside of the 25-75th percentile of average weekly flow values) during the study period.

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

The cost of the study will be moderate to high, as seasonal sampling with several types of gear will be required. However, cost will also be partially dependent on the number of sites sampled, the number of sample replicates, and the extent of the covariate data that are measured. Provided the collected data are of high quality, analysis and synthesis should take approximately 10-20 days. TransCanada did not propose any studies specifically addressing this issue

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TransCanada Study Request #16

Determine Upstream Passage Needs for Riverine Fish Species in the Bellows Falls, Wilder and Vernon Fishways

(Bellows Falls, P-1855; Wilder, P-1892; Vernon, P-1904)

Goals and Objectives

The goal of this study is to determine the adequacy of the existing Bellows Falls, Wilder, and Vernon fish ladders in passing riverine species and determine the appropriate operation period for these fishways to pass riverine and diadromous fish.

Specific objectives include:

1. identify the utilization and temporal distribution of passage through the Bellows Falls, Wilder, and Vernon fishways by riverine and diadromous fish species;
2. review existing Vermont Fish and Wildlife Department's (VTFWD) fish passage data to increase sample size and gain a better understanding of temporal variability; and
3. operate and monitor the fishways year-round (or until otherwise infeasible) to assess fishway use over a longer period than the fishways have traditionally been operated to:
    a. determine the appropriate operating windows of the fishways for riverine species; and
    b. determine the appropriate operating windows of the fishways for diadromous species such as American eel and sea lamprey.

Resource Management Goals

The U.S. Fish and Wildlife Service (Service) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the projects.

Specific to aquatic resources, the Service's goals are:

1. Protect, enhance, or restore diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the areas impacted by project operations.

3. Minimize current and potential negative project operation effects on water quality and aquatic habitat.

The VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Vermont's Wildlife Action Plan 2005).

Two of the VTFWD's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

The VTFWD's Strategic Plan (2002-2010) focuses on four major areas of concern: resource conservation, fish- and wildlife-based recreation and use, human health and safety, efficient operations, and effective management.

A mission of the New Hampshire Fish and Game Department (NHFGD) is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats.

Three of the NHFGD's goals are to ensure:

1. New Hampshire has a wide range of naturally occurring habitats and health, functioning ecosystems.
2. New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3. New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.

In order to be consistent with both Departments' missions and goals, and to promote healthy fish populations, connectivity within a river system is important. By allowing fish to move through the fishway during different times of the year, and during different life history stages, access to available riverine aquatic habitat is increased. Fish are able to seek the best available habitat and food resources, as well as avoid predator interactions. Furthermore, movement within a river system promotes genetic diversity. Currently upstream resident fish passage at the Bellows Falls, Wilder, and Vernon dams is precluded most of the year due to fishway closure.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

Public Interest

The requestor is a natural resource agency.

Existing Information

No such information exists that will allow for a comprehensive assessment of existing year round fishway utilization by resident species. The VTFWD has several years (2007-2012) of seasonal passage data that have not yet been analyzed. These data are in the form of .avi files, but only include the spring and summer months (typically May-July).

The PAD acknowledges that "Resident species have also been recorded using the Bellows Falls and Wilder fish ladder." Those data are available from the VTFWD. Fish passage video data that have been processed should be available for distribution in the future (Lael Will, VTFWD, personal communication). Although not comprehensive, analysis of these data would assist in filling this data gap.

In 2012, VTFWD staff documented resident species passage at the Vernon fishway. Species observed utilizing the fishway included bluegill (N = 555), common carp (N = 209), channel catfish (N = 37), trout sp. (N = 2), walleye (N = 54), white sucker (N = 102), and American eel (N =262). However, these analyses were conducted during one year and did not include any monitoring outside of the spring spawning run.

Nexus to Project Operations and Effects

The Bellows Falls, Wilder and Vernon dams span across the Connecticut River, acting as a physical impediment to fish passage. Therefore, the projects have a direct impact on fish passage and limit fish from accessing available aquatic habitat located upstream of the dam.

The PAD acknowledges that "river fragmentation can reduce or obstruct fish and aquatic community connectivity and therefore genetic diversity and stock structure. However, those impacts are reduced by the provision of fish passage and the length of the impoundment. Upstream and downstream fish passages, designed for Atlantic salmon, are likely used by other migratory and resident species, providing connectivity; however, fish counts are limited, unknown or unavailable for resident species." In fact, it is known that riverine and diadromous species use the fishways, but there has been limited analysis of this data and fishway monitoring was limited to the spring period.

Therefore, in order to determine the level of riverine fish passage through the existing fishways, and the appropriate operation period for the fishway, review of existing data and further monitoring of the fishways is warranted.

Methodology Consistent with Accepted Practice

Fishway monitoring has been conducted annually by VTFWD dating back to 1985. Monitoring was focused on Atlantic salmon, American shad and American eel. Resident species were recorded periodically, but were not monitored outside the spring anadromous fish migration period.

Fishway monitoring has been used to assess existing and proposed project operations, and to develop appropriate operating windows for fisheries resources.

In addition to fish window count data, monitoring should include monitoring of the hydraulic conditions in the fishways and fishway entrances, and periodic fish observations should be made over the length of the fishways. If count data or observations of the fishways indicate the need for fishway operation changes or for more specific information on fish movement through the fishways, changes to the monitoring plan for year two monitoring would need to be implemented.

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

This study will require video monitoring equipment, appropriate software (e.g., salmon soft), and personnel to read files and manage the equipment. Some information already exists in the form of .avi files and past count data and are readily available from VTFWD. No other tool (e.g., radio telemetry) is more appropriate or cost effective for these types of assessments. Cost is relatively low.

TransCanada Study Request #17

Impacts of the Vernon, Bellows Falls and Wilder Project Impoundment Level Fluctuations on Resident Fish Spawning

(Bellows Falls, P-1855; Wilder, P-1892; Vernon, P-1904)

Goals and Objectives

The goal of this study is to determine if the full range of water level fluctuations in the Vernon, Bellows Falls and Wilder hydroelectric projects negatively impact resident fish species in the impoundments, and if impacts are found to occur, to develop appropriate mitigation measures.

Specific objectives include:

1. delineate, quantitatively describe (e.g., substrate composition, vegetation type and abundance) and map shallow water aquatic habitat types subject to inundation and exposure due to project operations, noting and describing additional areas where water depths at lowest operational range are wetted to a depth less than one foot (flats, near shore areas, gravel bars, with very slight bathymetric change);
2. conduct analyses of the impacts of the normal operation and the maximum permitted reservoir fluctuation range on the suitability of littoral zone habitats for all life stages of target species likely to inhabit these areas;
3. conduct field studies to assess timing and location of fish spawning;
4. conduct field studies to evaluate potential impacts of impoundment fluctuation on nest abandonment, spawning fish displacement and egg dewatering, and
5. evaluate potential impoundment fluctuation ranges and how implementation of such changes would mitigate for identified impacts.

Resource Management Goals

The U.S. Fish and Wildlife Service (Service) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the projects.

Specific to aquatic resources, the Service's goals are:

1. Protect, enhance, or restore diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.

2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the areas impacted by project operations.
3. Minimize current and potential negative project operation effects on water quality and aquatic habitat.

A mission of both the New Hampshire Fish and Game Department and the Vermont Fish and Wildlife Department is to protect and conserve fish and their habitats. Resident fish species are an important component of the Connecticut River's ecology and in some cases are the basis for a sport fishery. This requested study will help protect and conserve resident fish species by ensuring project operations do not negatively impact their spawning success.

The New Hampshire Department of Environmental Services is responsible for ensuring that surface water quality standards are met in all surface water bodies. The surface water quality criteria for Biological and Aquatic Community Integrity are:

1. The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms and have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.
2. Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

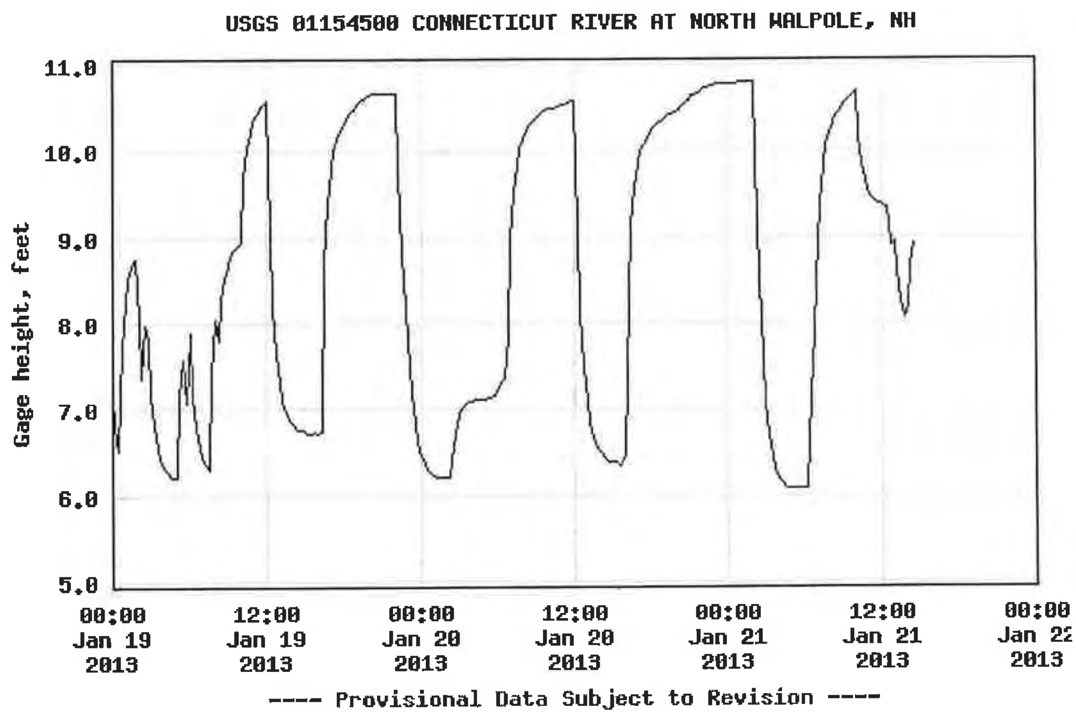
Public Interest

The requestor is a federal natural resource agencies.

Existing Information

To our knowledge, no information exists related to this requested study.

An example of the water level fluctuations that occur in the lower Connecticut River due to hydropower generation is shown below.



Nexus to Project Operations and Effects

Project operations have the potential to impact fish species by influencing spawning success and spawning habitat quality and quantity. For example, water level changes due to project operations could create conditions where fish eggs are exposed to air, where quality spawning habitat is dewatered, and/or where fish abandon nests containing eggs. The New Hampshire Fish and Game Department has received several calls in past springs regarding "acres" of yellow perch eggs being dewatered in the Bellows Falls Impoundment.

The projects operate within normal, permitted and flood-condition reservoir fluctuation limits that include, during high flow events, the dropping of stanchion bays that cannot be raised without a subsequent drawdown of the impoundment beyond normal project operating ranges. The full range of reservoir fluctuations, including periodic drawdowns for stanchion bay replacement, needs to be addressed in this study.

Methodology Consistent with Accepted Practice

Common tools to evaluate fish spawning and habitat would be used, including, but not limited to, electrofishing, visual observations, telemetry and habitat measurements. The study area for this request includes all impounded waters, including tributaries and backwaters, within the project-affected areas of the Vernon, Bellows Falls and Wilder hydroelectric projects. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year proves to be atypical (outside of the 25-75th percentile of average weekly flow values) during the study period.

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

TransCanada does not propose any studies to meet this need. Estimated cost for the study is moderate to high but is dependent on the amount of field study that is needed.

TransCanada Study Request #18

Impacts of the Vernon, Bellows Falls and Wilder Project Operations on Tributary and Backwater Area Access and Habitats

(Bellows Falls, P-1855; Wilder, P-1892; Vernon, P-1904)

Goals and Objectives

One goal of this study is to determine if water level fluctuations from the Vernon, Bellows Falls and Wilder hydroelectric projects result in a barrier(s) to fish movement in and out of tributaries and backwaters to the impoundments and riverine reaches below dams.

A second goal is to determine if water level fluctuations in the Vernon, Bellows Falls and Wilder project impoundments impact water levels, available fish habitat and water quality in tributaries and backwaters to the impoundments and riverine reaches below dams, and if impacts are found, to ascertain how spatially far reaching they are and develop mitigation measures.

Results of this study may also be used to help determine the adequacy of existing downstream minimum flow requirements.

Specific objectives include:

1. Conduct a field study of tributaries and backwaters, including water velocity and habitat data where appropriate, to evaluate potential impacts of impoundment fluctuation on fish access to tributaries and backwater areas. The study should also evaluate if changes in impoundment fluctuation range would mitigate for any identified impacts and if other mitigative measures would improve access.

2. Conduct a field study to examine potential impacts of impoundment fluctuations on water levels, available habitat and water quality in tributaries and backwaters. The evaluation should also evaluate if changes in impoundment fluctuation range would mitigate for identified impacts and if other mitigative measures would lessen these impacts.

Resource Management Goals

The U.S. Fish and Wildlife Service (Service) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the projects.

Specific to aquatic resources, the Service's goals are:

1. Protect, enhance, or restore diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the areas impacted by project operations.
3. Minimize current and potential negative project operation effects on water quality and aquatic habitat.

A mission of both the New Hampshire Fish and Game Department and the Vermont Fish and Wildlife Department is to protect and conserve fish and their habitats. Diadromous and resident riverine fish species are an important component of the Connecticut River's ecology and in some cases are the basis for a sport fishery. Furthermore, two of the states' Species of Greatest Conservation Need (SGCN) that would potentially be impacted have been documented in the project-affected areas.

The New Hampshire Department of Environmental Services is responsible for ensuring that surface water quality standards are met in all surface water bodies. The surface water quality criteria for Biological and Aquatic Community Integrity are:

1. The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms and have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.
2. Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

Diadromous and resident riverine fish are important components of the ecology of the Connecticut River.

This requested study will help promote tributary and backwater access and protect valuable fish habitat, and maintain appropriate water quality conditions for diadromous and riverine fish species in project-affected areas. Maintaining connectivity between the mainstem of the Connecticut River and tributaries and backwaters is vital to the fish populations in these systems, as many fish species utilize these areas for spawning, rearing, refuge, and feeding.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

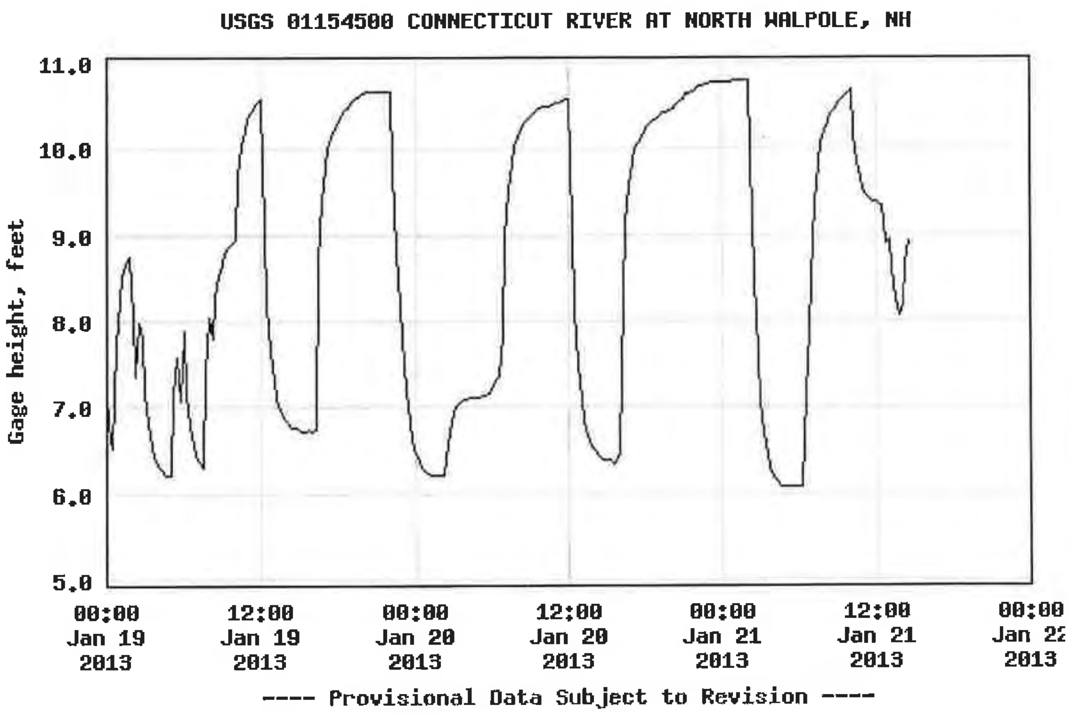
Public Interest

The requestor is federal natural resource agency.

Existing Information

To our knowledge, no information exists related to this requested study.

An example of the water level fluctuations that occur in the lower Connecticut River due to hydropower generation is shown below.



Nexus to Project Operations and Effects

Project operations have the potential to impact fish species life history requirements, biological interactions, and habitat quantity and quality. For example, water level changes due to project operations could create conditions that could impede free movement of fish between tributaries/backwaters and the mainstem of the Connecticut River, thus limiting access to spawning habitat and/or growth opportunities. Additionally, water level changes could also alter tributary and backwater fish habitat quality, quantity, and also water quality, thus decreasing productivity and available habitat. Furthermore, two of New Hampshire and Vermont's SGCN that could be impacted have been documented in the project-affected areas.

Methodology Consistent with Accepted Practice

Common tools to evaluate water level impacts would be used, including bathymetric mapping, substrate, depth and velocity measurements, and water quality information (dissolved oxygen, temperature, turbidity, and pH). Studies should be conducted throughout the year.

The study area for tributary and backwater fish sampling should cover all tributaries and backwaters within the project-affected areas of the Vernon, Bellows Falls and Wilder hydroelectric projects. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year prove to be atypical (outside of the 25-75th percentile of average weekly flow values) during the study period.

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

TransCanada does not propose any studies to meet this need. Estimated cost for the study is relatively low.

TransCanada Study Request #19

Impacts of Water Level Fluctuations on Aquatic Vegetation, Including Invasive Species, in the Vernon, Bellows Falls and Wilder Project Impoundments and Riverine Reaches

(Bellows Falls, P-1855; Wilder, P-1892; Vernon, P-1904)

Goals and Objectives

The goal of this study is to determine if the full range of water level fluctuations from the Vernon, Bellows Falls and Wilder hydroelectric projects negatively impact emergent aquatic vegetation (EAV) and submerged aquatic vegetation (SAV) and their habitats in the impoundments and riverine reaches below the dams.

The objective is to conduct field studies in mainstem littoral zones, tributaries and backwaters to determine if EAV and SAV species distribution and abundance, and their habitats, are impacted by current water level fluctuations permitted under the TransCanada projects' licenses; whether aquatic vegetation and its habitats can be enhanced by modifications to project operations or other mitigation measures; and whether there is any unique or important shoreline or aquatic habitats that should be protected. Results of this study may also be used to help determine the adequacy of existing downstream minimum flow requirements.

The specific objectives of the field study, at a minimum, include:

1. quantitatively describe and map wetland types within 200 feet of the shoreline, and describe associated wildlife;
2. delineate, quantitatively describe, and map all wetland types including invasive species and wildlife observed (e.g., bald eagle nesting, waterfowl nesting) within 200 feet of the shoreline, and the extent of this habitat if it extends beyond 200 feet; and
3. quantitatively describe (e.g., substrate composition, vegetation type and abundance) and map shallow water aquatic habitat types subject to project operation inundation and exposure, noting and describing additional areas where water depths at lowest operational range are wetted to a depth less than one foot (flats, near shore areas, gravel bars, with very slight bathymetric change).

The field study should produce a habitat inventory report that includes:

1. the results of the field study in the form of maps and descriptions;
2. an assessment of project effects on wetland, riparian, littoral zone vegetation and shallow water habitats, invasive plant species, and wildlife habitat at the project; and
3. recommendations for any necessary plant, habitat type, or wildlife, protection and/or invasive species control measures.

Resource Management Goals

The U.S. Fish and Wildlife Service (Service) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the projects.

Specific to aquatic resources, the Service's goals are:

1. Protect, enhance, or restore diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Minimize current and potential negative project operation effects on water quality and aquatic habitat.

A mission of both the New Hampshire Fish and Game Department and the Vermont Fish and Wildlife Department is to protect and conserve fish and their habitats. Riverine fish species are an important component of the Connecticut River's ecology and in some cases are the basis for a sport fishery. Aquatic vegetation is crucial fish habitat, as the majority of fish in the project impoundments utilize EAV and SAV at some point during their life history. This requested study will help enhance EAV and SAV in the project impoundments.

The New Hampshire Department of Environmental Services is responsible for ensuring that surface water quality standards are met in all surface waterbodies. The surface water quality criteria for Biological and Aquatic Community Integrity are:

1. The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms and have a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.
2. Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.

Aquatic vegetation, such as EAV and SAV, is an important component of the ecology of the Connecticut River.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

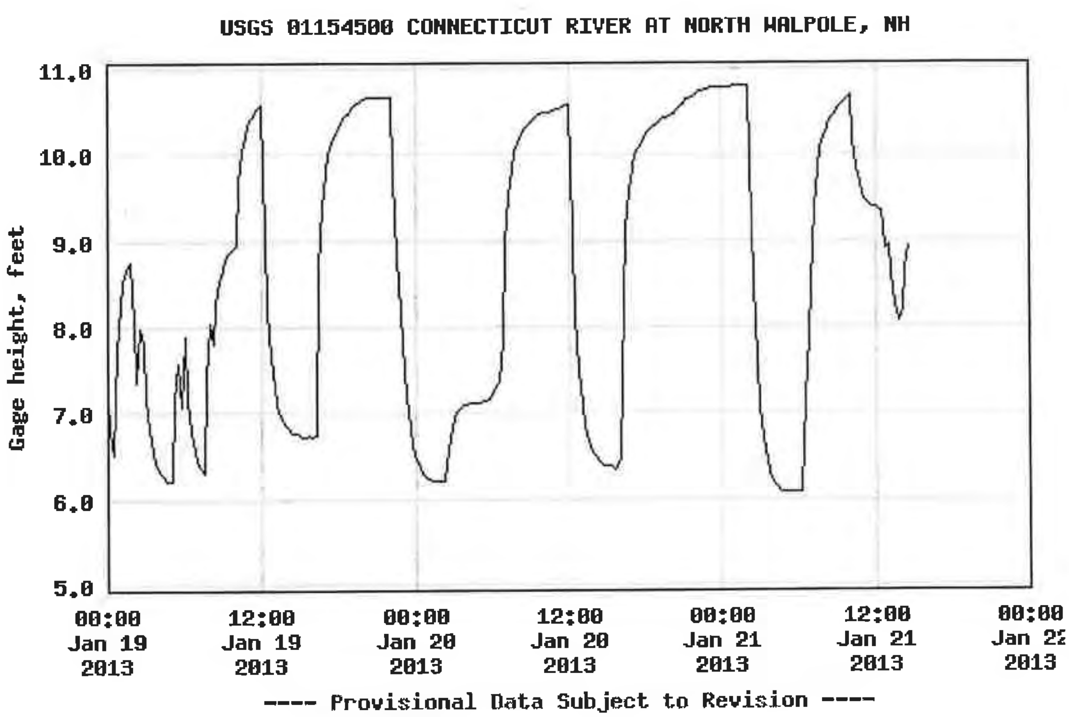
Public Interest

The requestors are natural resource agencies.

Existing Information

Existing information in the PADs does not quantify EAV and SAV. However, the Applicant acknowledges that water level fluctuations caused by the project have the potential to affect fringing wetland and littoral areas: "The average daily water level fluctuation of 2.5 vertical feet has resulted in a zone of sparse vegetation along most of the shorelines of the impoundment. Wetland and littoral resources in this zone are limited by the frequent wetting and drying." (Wilder PAD, p. 3-104; see also similar language in the Bellows Falls PAD, p. 3-115, and the Vernon PAD, p. 3-143).

An example of the water level fluctuations that occur in the lower Connecticut River due to hydropower generation is shown below.



Nexus to Project Operations and Effects

Water level fluctuations due to project operations have the potential to influence fish species life history requirements, biological interactions, and habitat quantity and quality by impacting EAV and SAV. For example, water level changes due to project operations could create conditions where EAV and SAV abundance is diminished, thus negatively impacting a habitat used by riverine fish for spawning, rearing, feeding, and cover. Additionally, water level fluctuations due to project operations could influence EAV and SAV habitat in the project impoundments and promote invasive plants over native species. This study needs to take into account existing and potential future limits on impoundment level fluctuations intended to limit recreation impacts, and the interactions of any changes in pond level fluctuation range or frequency and discharge changes.

Methodology Consistent with Accepted Practice

Vegetation mapping and mapping of littoral zones in relation to water level fluctuations are common tools for identifying EAV and SAV that may be impacted by changes in water levels. The study should include field surveys designed to describe the characteristics of each mapped wetland, riparian, littoral and shallow water habitat, including plant species composition, relative abundance/density, habitat quality, and land use. These surveys should be conducted to describe these habitats at the lowest water level operational range permitted on a daily operation schedule, under low flow conditions. Information collected should include:

1. plant species composition, and their relative abundance/density and condition/structure (e.g., seedlings);
2. surveying for the federally endangered Northeastern bulrush (*Scirpus ancistrochaetus*);
3. structured data, including estimates of average heights and aerial cover of each vegetation layer (specifically denoting invasive species);
4. aquatic habitat substrate composition, quantity (i.e., percent types and area), wood structure (relative abundance measure applied by area), water depths (inundated, exposed, and water less than one foot);
5. predominate land use(s) associated with each cover type;
6. notation of wildlife sightings;
7. field-verified wetland, riparian, and littoral and shallow water habitats and invasive species occurrences (should be geo-referenced as polygons and overlain on orthophoto at a suitable scale); and
8. identification (mapped location, total area) of any EAV, SAV or other fish habitat (i.e., wood, rocks, etc.) that is dewatered at the lowest water level operational range permitted on a daily operation schedule, under low flow conditions.

Bathymetric mapping of the littoral zone will be needed to model the extent of this zone that will be affected by different water fluctuation scenarios.

The study area is from the most upstream area influenced by the Wilder Dam to the most downstream area influenced by the Vernon Dam. Water level fluctuations caused by the projects may affect not only the impoundments, but also the downstream river reaches below the dams. Studies would occur in the main river littoral zone and in backwater areas during spring, summer and fall. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year proves to be atypical (outside of the 25-75th percentile of average weekly flow values) during the study period.

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

Although the PADs acknowledge that project operations have the potential to impact littoral resources, TransCanada did not propose any studies concerning aquatic vegetation. Analysis as described above is needed to understand potential impacts of the projects on these resources. Estimated cost for the study is moderate due to the need for field assessment.

TransCanada Study Request #20

Water Quality Monitoring
(Bellows Falls, P-1855; Wilder, P-1892; Vernon, P-1904)

Goals and Objectives

The goal of this study is to determine if the operational impacts of the Vernon, Bellows Falls and Wilder hydroelectric projects are causing or contributing to violations of New Hampshire and/or Vermont state water quality standards.

The specific objectives of this study are as follows:

1. Characterize water quality in the impoundments, Bellows Falls bypass reach, Bellows Falls canal and project tailraces.
2. Evaluate the potential effects of project operations on water quality parameters such as temperature and dissolved oxygen (DO) in conjunction with various other water uses.

Resource Management Goals

The U.S. Fish and Wildlife Service (Service) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the projects.

Specific to water quality within the project areas, the Service's goals are:

1. Protect, enhance, or restore diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Minimize current and potential negative project operation effects on water quality and aquatic habitat.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

Public Interest

The requestor is a natural resource agency.

Existing Information

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont water quality standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Vermont lists the section of the Connecticut River below the Wilder dam on the Section 303(d) impaired water list due to flow alterations, aquatic life and habitat.

All sections of the Connecticut River related to the projects are classified by New Hampshire as Class B. It should be noted that although the classification name is the same as Vermont's, New Hampshire surface water criteria for Class B waters are, in some cases, different from Vermont's.

New Hampshire surface water quality standards (Env-Wq 1703.01) state that the surface water quality criteria for all surface waters shall be restored to meet the water quality criteria for their designated classification, including existing and designated uses, and to maintain the chemical, physical, and biological integrity of surface water.

The PADs contain information on water quality monitoring that was completed by TransCanada between June 20, 2012 and September 11, 2012 within the project areas.

Vernon Project: Continuous water quality data were collected in the tailrace and immediately upstream of the dam. Additionally, weekly water column profiles were collected at three locations within the impoundment. Results indicated that water temperature reached critical threshold levels for salmonids. Summary results presented in the PAD indicate that, in general, temperature and pH increased from upstream to downstream while DO decreased, reflecting the impacts of the impoundment on increased travel time in the river.

Bellows Falls Project: Continuous water quality data were collected in the tailrace, bypass reach, and immediately upstream of the dam. Additionally, weekly water column profiles were collected at three locations within the impoundment. The data indicated that Vermont and New Hampshire water quality standards for DO were not met in the bypass reach and in the impoundment. Furthermore, pH readings collected in water profile measurements indicated that in two different locations during two separate events, the impoundment did not meet Vermont and New Hampshire water quality standards. Summary results presented in the PAD indicate that, in general, temperature and specific conductivity increases from upstream to downstream within the impoundment.

Wilder Project: Continuous water quality data were collected in the tailrace and immediately upstream of the dam. Additionally, weekly water column profiles were collected at three locations within the impoundment. The data indicated that Vermont water quality standards for DO were not met during a seven-day period in August. Summary results presented in the PAD indicate that, in general, temperature and specific conductivity increased from upstream to downstream while DO decreased, reflecting the impacts of the impoundment.

All projects: The way the results are presented in the PADs does not allow for an adequate understanding of how water quality is affected by project operations.[1] Further, the results that were presented indicate that water quality standards are not being met at certain times at some of the projects. TransCanada does not propose to continue the water quality monitoring effort it began last summer. Additional monitoring is needed so that resource agencies can properly evaluate the potential impact of project operations on water quality.

Nexus to Project Operations and Effects

The projects impound many miles of river that would otherwise be free flowing (26 miles each at Vernon and Bellows Falls, and 45 miles at Wilder). All projects currently operate in a peaking mode, with allowable impoundment fluctuations from three feet at Bellows Falls up to eight feet at Vernon, with proposals to continue as such. The below-project flow requirement at each project is equal to 0.20 csm. There is no flow requirement for the 3,500-foot-long bypass reach at the Bellows Falls Project. Water quality can be affected by the operating mode of a hydropower project. The PADs provide limited information on how project operations affect water quality within the project areas.

Operation of the projects must conform to Vermont and New Hampshire water quality standards. The Service requests a study that will provide the data needed to determine if the Connecticut River in the vicinity of the projects is or is not attaining the water quality standards of both states.

Methodology Consistent with Accepted Practice

The methodology for this study should be similar to TransCanada's water quality monitoring in 2012, including weekly vertical profiles within the impoundment, weekly water quality samples of nutrients and chlorophyll-a for laboratory analysis and the deployment of multi-parameter continuous data loggers at multiple locations within the impoundment and tailrace. An additional site should be monitored in the free-flowing section of the river above the impoundment to serve as a "reference site." In order to ensure that data are collected during a time of important biological thresholds and anticipated "worst case" conditions for DO (low flow, high temperature, antecedent of any significant rainfall event), we recommend deploying continuous data loggers at all locations, with biweekly vertical profiles taken at the deep impoundment locations from April 1 through November 15. Results should include date, time of sampling, sunrise time, GPS location, generation status (estimated flow through power stations, spillway gates and Bellows Falls bypass reach), precipitation data, water temperature, DO concentration, and percent saturation. Water quality results should be graphically compared to both state water quality standards and project operations, including the generation status, impoundment elevation, and discharge.

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1 With the exception of trends in water temperature. Monitoring results show that both the mean and median temperature increased by 10°F (6°C) from the uppermost monitoring station in the Wilder impoundment down to the Vernon tailrace station. The cumulative impact of the three long impoundments on water temperature is of concern to the Service, particularly in the context of climate change.

If river flow and temperature conditions are representative of an "average" or "low" water year, then one year of data collection should be sufficient to perform the study. If conditions are not representative (i.e., a "wet" or cool year), a second year of data collection may be necessary.

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

The cost and effort for this study will be moderate. It is expected to take two technicians approximately three days to deploy the loggers, twelve days to collect the vertical profiles, three days to remove the loggers, three days to download the data, and two weeks to write the report. TransCanada has proposed no studies to address this information need.

TransCanada Study Request #21

Climate Change as it Relates to Continued Operation of the Vernon, Bellows Falls, Wilder, Northfield Mountain Pumped Storage, and Turners Falls Projects

(Turners Falls, P-1889; Northfield Mountain, P-2485; Bellows Falls, P-1855; Wilder, P-1892; Vernon, P-1904)

Goals and Objectives

The goal of this study is to determine how climate change relates to the continued operation of the Vernon, Bellows Falls, Wilder, Northfield Mountain Pumped Storage (NMPS), and Turners Falls projects.

The objectives of this study are:

1. Quantify the amount of thermal loading contributed by each respective impoundment (including the NMPS upper reservoir).
2. Using climate change prediction models, calculate how much warmer the project impoundments are projected to get in the next 30-50 years.
3. Model the effect of various project modifications on river temperature under current conditions and climate change predictions (e.g., converting to run-of-river, deep-water releases, dam removal, large-scale riparian revegetation, etc.).
4. Using climate change prediction models, determine if the projects actually provide an environmental benefit with respect to mitigating against climate change impacts (vis a vis warming of air and water temperatures) by producing low greenhouse gas emitting energy. The NMPS assessment must be based on net energy production (i.e., NMPS generates 1,143,038 MWh annually, but consumes 1,567,506 in its pumping operations, for a net consumption of 424,468 MWh annually).
5. Determine how climate change predictions will impact management of high flow events at the three projects and evaluate if changes to dam structures would mitigate adverse impacts of the existing flood management protocols.

Resource Management Goals

The U.S. Fish and Wildlife Service (Service) seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the projects.

Specific to climate change, the Service's goals are:

1. Minimize current and potential negative project operation effects that could hinder management goals and objectives.
2. Minimize deep headpond drawdowns associated with the loss of stanchion logs during high flow events, which are predicted to increase due to climate change.
3. Minimize project-related sources of thermal increases to Connecticut River waters to mitigate against predicted climate change impacts.

The Service, along with the National Oceanic and Atmospheric Administration (NOAA) and the Association of Fish and Wildlife Agencies, developed a draft *National Fish, Wildlife and Plants Climate Adaptation Strategy* (Strategy) in 2012. The public comment period closed on March 5, 2012, and the agencies are working to finalize the document. Goal #7 of the Strategy calls for reducing non-climate stressors to help fish, wildlife, plants, and ecosystems adapt to a changing climate. The Strategy notes that some stressors (such as habitat loss and fragmentation and pollution) "are not only some of the things decision makers can control, they are also likely to interact with climate change to magnify negative impacts on fish, wildlife, and plants."

Goal #7 contains a number of strategies and associated actions, including:

Strategy 7.1: Slow and reverse habitat loss and fragmentation

Actions:

1. Consider application of offsite habitat banking linked to climate change habitat priorities as a tool to compensate for unavoidable onsite impacts and to promote habitat conservation or restoration in desirable locations.
2. Identify options for redesign and removal of existing structures/barriers where there is the greatest potential to restore natural processes.

Strategy 7.2: Slow, mitigate, and reverse where feasible ecosystem degradation from anthropogenic sources through…water resource planning, pollution abatement…

Actions:

1. Work with….water resource…planners to identify potentially conflicting needs and opportunities to minimize ecosystem degradation resulting from development and land and water use.
2. Reduce existing pollution and contaminants and increase monitoring of air and water pollution.
3. Increase restoration, enhancement, and conservation of riparian zones and buffers in agricultural and urban areas to minimize non-point source pollution.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq.*), and the Federal Power Act (16 U.S.C. §791a, *et seq.*).

Public Interest

The requester is a resource agency.

Existing Information

The PAD contains no information relative to climate change and how climate change predictions may impact future operation of the hydroelectric plants, nor of how the projects either mitigate for or exacerbate predicted climate change impacts to freshwater ecosystems.

TransCanada's PAD provides a summary of water quality data collected in 2012. Table 1 below is a synthesis of the temperature data collected by TransCanada. It should be noted that the upper and mid-impoundment stations at each project represent the average of temperature readings taken over the entire water column, while the continuous loggers (Lower Cont. and TR) were located near the water surface. These data indicate that from the upstream end of the Wilder headpond to the Vernon tailrace, water temperature increased approximately 6°C.

Table 1. Median water temperature at monitoring stations located within the impoundments and tailraces of the three hydropower projects.

	Median Water Temperature °C			
Project	Upper Imp.	Mid-Imp.	Lower Cont.	TR
Wilder	20.86	21.83	24.08	23.59
Bellows Falls	22.43	23.67	24.86	24.38
Vernon	23.81	24.49	26.73	26.35

Relative to existing flood management protocols at each station, TransCanada's PAD identifies that all three dams utilize stanchion bays (two at Vernon, three at Bellows Falls, and four at Wilder). When inflows to each dam reach certain levels, the stanchion bays are removed, and cannot be replaced until inflows subside. The depth of these bays and the flows at which they are removed are outlined in Table 2 below.

Table 2. Summary of pertinent stanchion bay information for the Vernon, Bellows Falls, and Wilder projects.

Project	Stanchion Height (feet)	Flow Complete Removal	Triggering Stanchion
Wilder	17	145,000 cfs	
Bellow Falls	13	50,000 cfs	
Vernon	10	105,000 cfs	

The PAD provides no information on the history of stanchion removal at any of the projects (frequency, duration, timing), nor a discussion of how predicted climate change might alter management of the stanchion bays in the future (with respect to the frequency and seasonality of occurrence). There also is no discussion of potential impacts to headpond resources that occur as a result of stanchion bay removal. These information gaps need to be filled so resource agencies can assess the relative and cumulative impact of project operations with respect to the Service's management goals and objectives, including those identified in the Strategy.

Data provided by NOAA, Climate Data Center, illustrates long-term increasing air temperatures in the Northeast (Figure 1). Long-term, monthly mean water temperature data for the Vernon Dam impoundment, monitored by Vermont Yankee, has shown significant differences over time (ANOVA analyses, $P < 0.05$) that when plotted and further analyzed by linear regression, show a significant increasing trend for the period 1974–2010 for the months of January, September, and October (Figure 2). These analyses were performed with data from Vermont Yankee, analyzed by the Massachusetts Department of Environmental Protection.

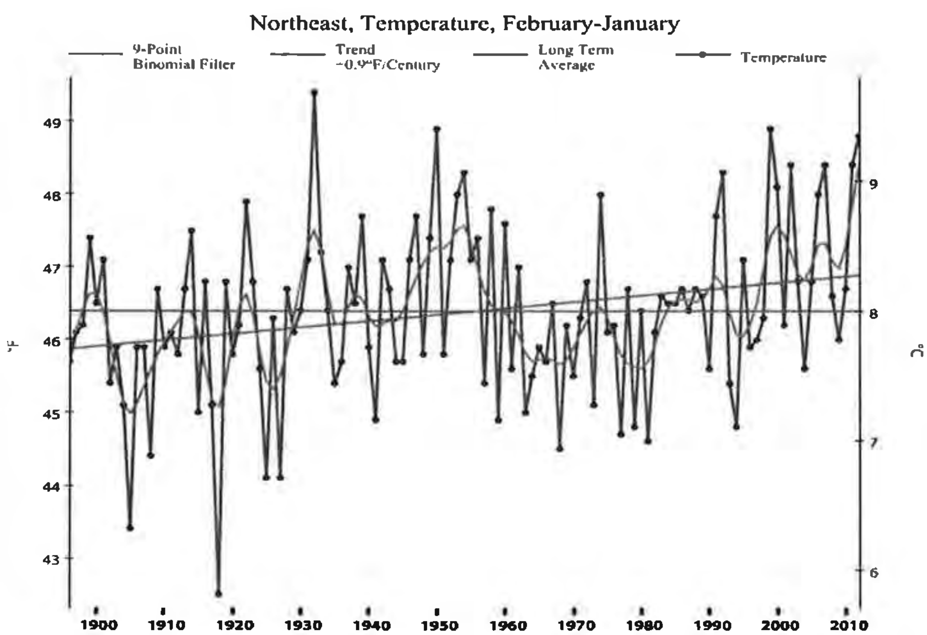

Figure 1. NOAA National Climate Data Center, Northeast 12-month average temperature for the period 1896 through 2012.

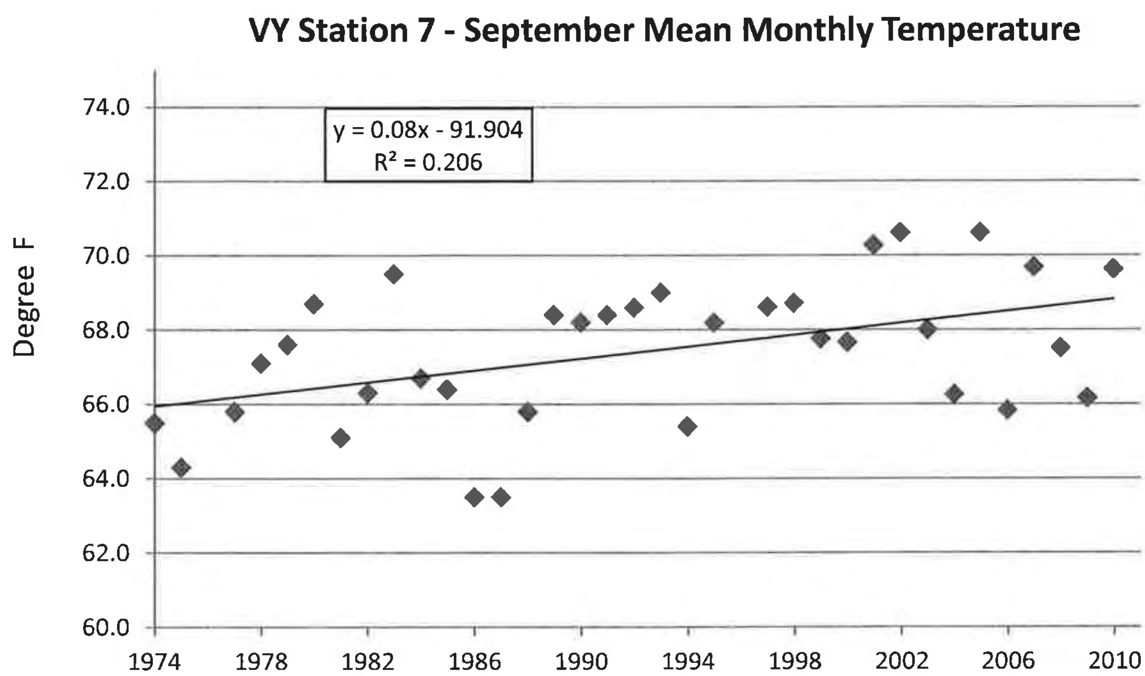

Figure 2. A plot of September's mean temperatures for Vermont Yankee's Station 7 (excludes outlier 1996 data point) for the period 1974 through 2010.

The PAD for the Turners Falls and NMPS projects provides a summary of existing water quality data compiled by FirstLight, including water temperature data obtained from the Service. The PAD also notes a 1991 study by the former licensee that modeled thermal effects of pumping to the upper reservoir. That model reported a maximum temperature difference attributable to NMPS operation of 0.21°C in the Turners Falls reach of the Connecticut River in low flow (4,000 CFS) simulation.

Nexus to Project Operations and Effects

The four mainstem projects have very long impoundments capable of storing large volumes of water (Table 3 below). These impoundments effectively have converted large portions of the Connecticut River into a series of in-river "lakes." Because water velocities slow in these impounded sections of the river, it allows for increased thermal loading and resultant higher water surface temperatures than in free-flowing sections of the river.

Table 3. Relevant characteristics of the reservoirs behind the Wilder, Bellows Falls, Vernon, Turners Falls dams and NMPS.

Project	Headpond Length (miles)	Gross Storage Volume (acre-ft.)	Average Depth (ft.)	Surface Area (acres)	Flushing Rate (days)
Wilder	45	34,350	11	3,100	3
Bellows Falls	26	26,900	10	2,804	<2
Vernon	26	40,000	16	2,550	2
Turners	20	21,500		2,110	
NMPS	n.a.	17,,050		246	n.a.

Depending on where the hydropower intakes withdraw water, these warmer surface waters may be discharged downstream, raising the temperature of those waters as well (the data in Table 1 above suggest that the projects do draw water from the upper levels of the reservoirs). This effect may be felt for miles downstream. If there are a series of impoundments (like on the Connecticut River), the cumulative impact is an overall warming of the river. Even small run-of-river dams have been shown to elevate downstream water temperature (Lessard and Hayes 2003; Saila *et al.* 2005). The most recent climate change prediction models specific to the Northeast forecast warmer air temperatures, more frequent high precipitation events, more heat waves, and an increase in the incidence of short-term droughts (Karl *et al.* 2009).

Resource concerns related to this project effect include the potential impacts to populations (reductions in abundance, structure, condition) or loss of species not tolerant of increases in temperature and other effects related to physiology such as energetic costs with warmer temperatures (Leggett 2004). As one example, American shad restoration target numbers for fish passage at mainstem dams into upstream historic habitat could be negatively impacted from artificially increased water temperatures. Water temperature has been identified as a factor in the timing (i.e., duration) of this species migration, as well as its role in gonad development and spawning (Glebe and Leggett 1981; Leggett 2004). These factors can be logically reasoned to result in accelerated rates of energy reserve use and a reduced migration window, possibly reducing the ability of fish to reach up-river habitats and further reducing the ability to survive downstream outmigration.

With respect to project operations during high flow events, all TransCanada projects have stanchion bays that are used to manage water during high flow events. Each time these stanchion bays are removed, the headponds are lowered substantially (from 10 to 17 feet, depending on the project) and must remain lowered until inflows subside. Depending on the timing and duration of these deep drawdowns, headpond resources could be negatively impacted.

All of the dams also contain other mechanisms for managing flows, such as tainter gates, sluice gates, roller gates, skimmer gates and hydraulic flood gates. All of these gates have an advantage over stanchion bays in that they do not require flows to subside significantly before they can be closed to return impoundment levels back to normal. One climate change prediction for the

Northeast is that we will see more frequent high precipitation events which will result in high flow conditions on rivers. Therefore, it is likely that the stanchion bay removal protocol will have to be employed more frequently in the future.

Methodology Consistent with Accepted Practice

1. In order to quantify the amount of thermal loading contributed by each respective impoundment, detailed bathymetry will need to be collected. This bathymetry, combined with storage volume, tributary hydrology, and project operations, should be used to calculate the thermal loading of each headpond. The individual and cumulative increase in surface water temperature due to the impoundments should then be used to predict future warming based on climate change models.

2. Analyze different mitigation strategies to understand which have the greatest benefit in terms of building resilience against the impacts of climate change on water temperature. Potential scenarios to analyze include converting the projects to run-of-river, implementing deep-water releases, removing one or more dams, conducting large-scale riparian revegetation, etc.).

3. Input to climate change models the amount of GHG emissions that would be generated if fossil fuel plants were producing the equivalent amount of net energy as the five hydropower projects to determine the impact on air and surface water temperatures.

4. Climate change prediction model output should be assessed to determine if the frequency and timing of high flow events are likely to change in the future. If high flow events that necessitate initiating the stanchion bay removal protocol are predicted to increase in frequency and/or shift in timing, the Applicant should evaluate structural and/or operational alternatives that would mitigate adverse impacts of the existing flood management protocols.

Level of Effort/Cost, and Why Alternative Studies Will Not Suffice

The level of cost and effort for the thermal loading analysis would be low to moderate. Collecting bathymetry in the three TransCanada headponds would take two staff members less than one week to collect (it took the Kansas Biological Survey two days to collect bathymetry at a 3,500-acre lake; Jakubauskas *et al.* 2011). Bathymetry for the Turners Falls pool and NMPS upper reservoir already exist. The remaining work would be desk-based, loading relevant information into an appropriate thermal loading model to compute the estimated thermal loading of each headpond and then comparing this information to surface water data from climate change prediction models.

The high flow flood protocol study is a desktop analysis that should require low cost and effort. Climate change models already exist and that output would be downloaded and analyzed. The remaining analysis requires a review of alternative means of managing flows without the use of stanchion bays.

The Applicant did not propose any studies to meet this need in the PAD.

REFERENCES

Glebe, B.D. and W.C. Leggett. 1981. Latitudinal differences in energy allocation and use during the freshwater migration of American shad and their life history consequences. Canadian Journal of Fisheries and Aquatic Sciences 38, 806-820.

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Karl, T.R., J.M. Melillo and T.C. Peterson. 2009. Global Climate Change Impacts in the United States. Cambridge University Press.

Leggett, W. C. 2004. The American shad, with special reference to its migration and population dynamics in the Connecticut River. Pages 181-238 in P. M. Jacobson, D.A. Dixon, W.C.

Lessard, J.L. and D.B. Hayes. 2003. Effects of elevated water temperature on fish and Macroinvertebrate communities below small dams. River Research and Applications.

Saila, S.B., D. Poyer and D. Aube. 2005. Small dams and habitat quality in low order streams. Wood-Pawcatuck Watershed Association. April 29, 2005. 16 pp.

Vermont Agency of Natural Resources

Study Requests

for

Wilder Hydroelectric Project
FERC No. 1892-026

Bellows Falls Hydroelectric Project
FERC No. 1855-045

Vernon Hydroelectric Project
FERC No. 1904-073

Turners Falls Hydroelectric Project
FERC No. 1889-081

Northfield Mountain Pumped Storage Project
FERC No. 2485-063

March 1, 2013

28	Assess the impact of project operations on state-listed rare, threatened and endangered plant species and significant natural communities	WBV	188
29	Survey the number, species and behavior of adult dragonflies and emerging nymphs within the project areas	WBV	194
30	Survey for new and existing populations of adult Cobblestone and Puritan tiger beetle populations within the project areas	WBV	198
31	Survey the distribution, population size and habitat conditions of Fowler's Toad (*Bufo fowleri*) within the project areas	WBV	201
32	Recreational survey and enhancement study	WBV	205
33	Assess the amount of development within the floodplain of the lower Connecticut River	WBV	207
34	Bellows Falls aesthetic flow study	B	209

[1]Project Codes: W – Wilder; B – Bellows Falls; V – Vernon; T – Turners Falls; N – Northfield Mountain Pumped Storage

Wilder Hydroelectric Project – FERC No. 1892-026

Study Request 1: Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations

Goals and Objectives

The goal of this study is to determine how project operations contribute to the shoreline erosion and riverbank failure within the impoundment and downstream of the Wilder Hydro Project.

The objectives of this study are to:

1. determine how water level fluctuations within the minimum and maximum operating range and discharges from peaking operations at the Wilder hydroelectric project contribute to shoreline erosion;
2. identify and determine the effects of shoreline bank erosion and riverbank failure on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.);
3. identify techniques that could be used to mitigate the effects of project operations or other mitigation techniques that could be developed to reduce on riverbank erosion within the impoundment and downstream of the tailrace.

Resource Management Goals

The Connecticut River is considered Class B water by the states of Vermont and New Hampshire. Vermont lists the section of the Connecticut River below the Wilder dam on the Section 303(d) impaired water list due to flow alterations resulting in the destabilization and eroding of shoreline impairing aquatic life and habitat. In Class B waters, Vermont's water quality standards state that water level fluctuation and flow alterations can only occur to the extent that it supports all uses and does not lead to degradation of the water resource or habitat. New Hampshire's surface water quality regulations state that "unless the flows are caused by naturally occurring conditions, surface water quantity shall be maintained at levels adequate to protect existing and designated uses." (Env-Wq 1703.01(d)). The specific New Hampshire water quality criteria for turbidity in Class B waters is not to exceed naturally occurring conditions by more than 10 NTUs (Env-Wq 1703.11).

Public Interest Consideration

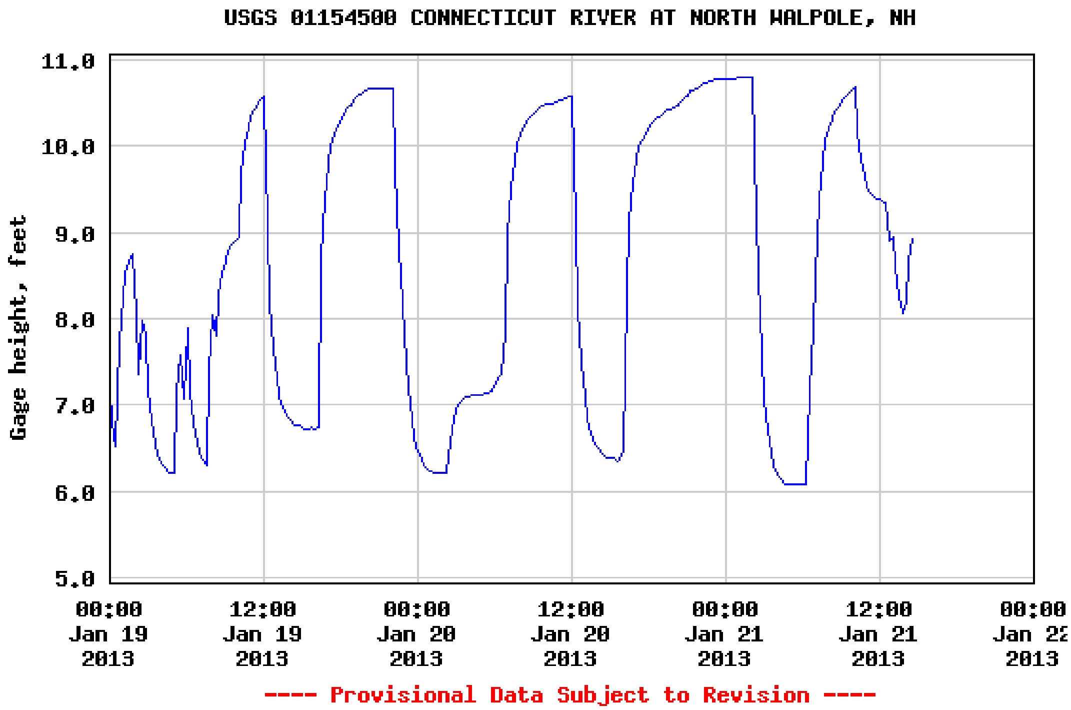
The Vermont Agency of Natural Resources and the New Hampshire Department of Environmental Services request this study. The requestors are state natural resource agencies.

Existing Information

The PAD references several studies pertaining to shoreline erosion within the Connecticut River, including the study by US Army Corp of Engineers (Simion et al. 1979). This study evaluated the shoreline within the Wilder impoundment and identified water level fluctuation and periodic high flow events as causes of shoreline erosion. The PAD also discusses the erosion survey that TransCanada initiated in 2010 to inventory sites where erosion is occurring within the Wilder impoundment (Kleinschmidt 2011). Bank slumping can occur when fluvial erosional forces act on the toe of the bank slope. The PAD did not address how project related operations contribute to shoreline erosion, could be changed to mitigate impacts on shoreline erosion, or discuss the impacts of shoreline erosion on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.).

Repetitive water level fluctuations and flow alterations caused by hydroelectric peaking operations are known to be a major contributor to shoreline erosion (Lawson 1985). Sediment from shoreline erosion and riverbank failure is one of the major contributors negatively affecting water quality and habitat by increasing turbidity and sedimentation, smothering aquatic habitat in the United States. Vermont Surface Water Management Strategy identifies sediment from excessive channel erosion as a stressor on Vermont water and aquatic habitat. Additionally, Vermont lists this section of the Connecticut River on the Vermont Section 303(d) impaired water list due to flow alterations resulting from the destabilization and eroding of shoreline impairing aquatic life and habitat.

An example of the water level fluctuations that occur in Lower Connecticut River due to hydropower generation is shown below.



Project Nexus

Wilder Hydroelectric Project operations currently result in daily water level fluctuation in the impoundment by as much as 2.5 feet, which has the potential to affect shoreline erosion in the impoundment. The project is currently permitted to water level fluctuation in the impoundment by 5 feet. Additionally the project "peaking" operation could contribute to bank erosion downstream of the dam by increasing the shear stress on the bank toe. Furthermore, river profile operations during high flow events minimize overland flow by drawing down the impoundment prior to high flows containing high velocity flows to the river channel, possibly increasing shoreline erosion rate within the impoundment. TransCanada is not proposing any changes to project operations.

Proposed Methodology

Kleinschmidt (2011) conducted a shoreline erosion survey on the Connecticut River, from which we have data on the spatial locations, lengths and heights of such erosion. However, this study did not investigate whether the practice of flow modification is a causative agent to this erosion. Consequently, the Vermont Agency of Natural Resources and the New Hampshire Department of Environmental Services recommend TransCanada further investigate sites on the Connecticut River to evaluate the processes that are active along banks. This investigation should build on the erosion survey that was previously completed by determining the process causing erosion at a site, the extent erosion is negatively affecting other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.), and determining how erosion could be stabilized or mitigated by changing project operations. This investigation can be completed performing the following tasks.

Task 1: Determine erosion and riverbank failure process at identified sites

Shoreline erosion areas and riverbank failure sites were identified during the Kleinschmidt (2011) survey. A survey similar to Kleinschmidt (2011) should be conducted to document if any additional erosion has occurred, and identify new sites of erosion within the impoundment, given the occurrence of Tropical Storm Irene since the Kleinschmidt survey. For each erosion site, the following erosion process element will be identified by determining soil type and subsoil characteristics (i.e. depth to bedrock, texture, rock content, signs of soil piping), reservoir water levels at the time of observation, water level fluctuation, climatic conditions, ground water seepage, wind-driven waves, boat waves, and recreation. Additional site characteristic to identify and record in the erosion survey will include but not be limited to an estimate of the length and average height of the erosional area, slope of the site, dominant vegetation cover types present, associated vegetation cover types present, an ocular estimate of total plant cover and total cover by plant class (tree, shrub, herbaceous) in surrounding undisturbed areas. Data from each shoreline erosion site will be recorded on a field form and entered into a database. In addition, a photograph or photographs will be taken of each site. Sites should be visited when water levels are lowest.

Erosion processes will be determined by field observations and applying site appropriate geology, geomorphic and hydrological principles. To evaluate the relative influence of water level fluctuations on existing shoreline erosion, a minimum of six select sites (three in the impoundment and three downstream of the dam) will be identified for more detailed measurements and observations. In aid of site selection, comparison of successive aerial photographs will be conducted to identify sites that have experienced visible bank movement. Data from erosion surveys will be examined to identify sites with varying conditions of riparian buffer, vegetation type and bank slope. The sites selected for detailed evaluation will represent different combinations of bank movement, riparian buffer, vegetation type and bank slope. In those bank sites that are selected, rebar pins will be inserted into the banks in a grid at varying heights with each rebar being horizontally level. Initial rebar pin installation will take place when the water level in the impoundment is at its authorized lowest elevation. Each rebar pin will be assigned an individual number and photographed, with the distance from the end of the pin to the bank material measured. A survey will also be conducted of each bank along several bank transects in the immediate vicinity of each site to accurately document bank shape as well as the location and elevation of each rebar and the water surface elevation at the beginning and end of each site visit. Pressure transducers (one in the air and one in the water) will also be installed at each site to automatically record how water surface elevation at each site varies with time.

Biweekly for a period of one year, each of the six sites will be revisited. During each revisit, the bank and each rebar pin will be photographed and the distance from the end of the pin to the bank material will be measured. Any slumping of a pin will be noted. If a pin is found dislodged or removed during a site visit, a new rebar pin will be reinstalled in the approximate location of the previously existing pin.. In addition, a survey of the bank and rebars will be conducted as described above. Surveys will be conducted in the same manner and will use the same benchmark each site visit. Data from pressure transducers will be downloaded and analyzed each site visit to ensure they are working properly. When this dataset is related to the flow record from existing stream gauges in the river segment, this evaluation will allow for a determination as to whether the erosion is Project related, and if so, how Project operations may be impacting the sites.

Task 2: Determining the effects of erosion on other resources

The effects of shoreline erosion and riverbank failure on other resources should be determined. This will required coordination between studies to determine the effects of erosion on riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, and recreation. Erosion sites identified as having an impact on resources will be assess to determine if project operations are causing erosion and a mitigation plan to protect the resource of interest should be developed.

Task 3: Development of a Shoreline Management Plan

The information that is collected during the study should be used to develop a Shoreline Management Plan for the impoundment. If results from the erosion evaluation suggest that Project operations are impacting erosion within the impoundment, further evaluation should be undertaken to determine if there is a feasible way to reduce impacts. This feasibility analysis will be based on field observations and knowledge of current erosion control and slope failure stabilization methods that may be suitable for sites. The analysis will provide a preliminary list of potential control measures necessary to reduce erosion at these sites. Detailed analyses for final design and construction of erosion and slope stabilization control measures will not be part of the study. As part of this process, the landowner should be identified for each of the erosion sites and future mitigation and stabilization techniques should be presented.

The study area for the shoreline erosion study should extend from the upstream end of the impoundment above the Wilder Dam to the beginning of the Bellows Falls impoundment. Water level fluctuations caused by the Project may affect not only the impoundment but also the downstream river reaches below the dam.

Level of Effort and Cost

The cost and effort of this study will be moderate, but is important to document the potential impact project operations on shoreline erosion and riverbank failure, and to determine how this may impact other resources.

Literature Cited

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Bellows Falls Hydroelectric Project – FERC No. 1855-045

Study Request 1: Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations

Goals and Objectives
The goal of this study is to determine how project operations contribute to the shoreline erosion and riverbank failure within the impoundment and downstream of the Bellows Falls Hydroelectric Project.

The objectives of this study are to:
1. determine how water level fluctuations within the minimum and maximum operating range and discharges from peaking operations at the Wilder hydroelectric project contribute to shoreline erosion;
2. identify and determine the effects of shoreline bank erosion and riverbank failure on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.);
3. identify techniques that could be used to mitigate the effects of project operations or other mitigation techniques that could be developed to reduce on riverbank erosion within the impoundment and downstream of the tailrace.

Resource Management Goals
The Connecticut River is considered Class B water by the states of Vermont and New Hampshire. Vermont list the section of the Connecticut River above and below Bellows Falls dam on the Section 303(d) impaired water list due to flow alterations resulting in the destabilization and eroding of shoreline impairing aquatic life and habitat. In Class B waters, Vermont's water quality standards state that water level fluctuation and flow alterations can only occur to the extent that it supports all uses and does not lead to degradation of the water resource or habitat. New Hampshire's surface water quality regulations state that "unless the flows are caused by naturally occurring conditions, surface water quantity shall be maintained at levels adequate to protect existing and designated uses." (Env-Wq 1703.01(d)). The specific New Hampshire water quality criteria for turbidity in Class B waters is not to exceed naturally occurring conditions by more than 10 NTUs (Env-Wq 1703.11).

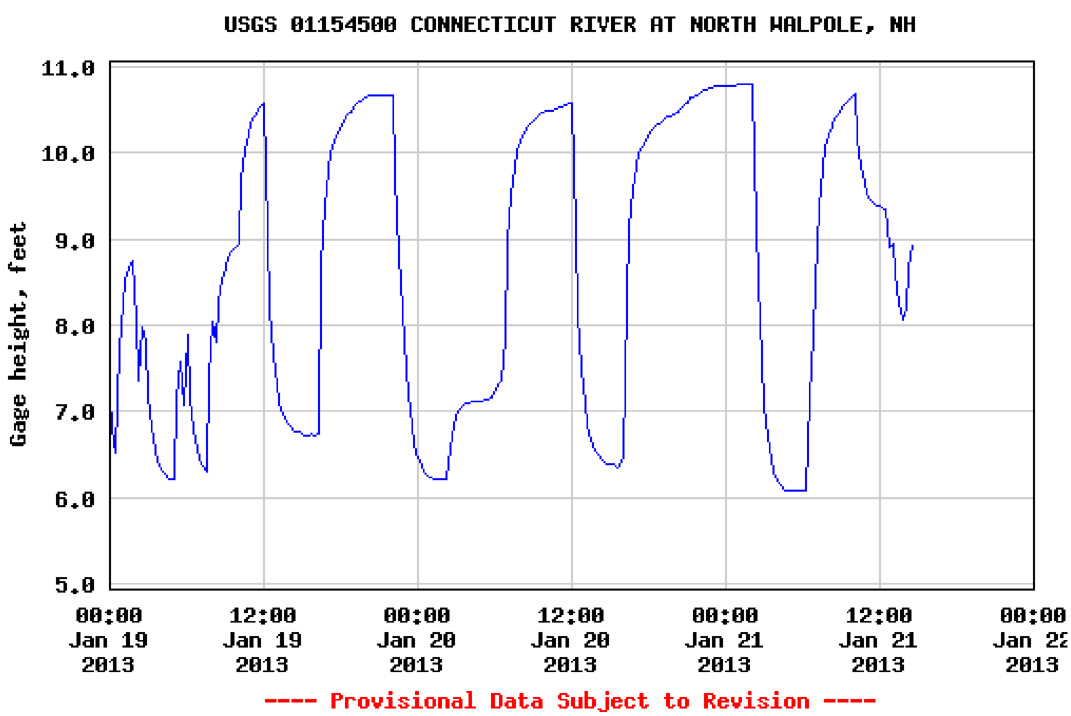
Public Interest Consideration
The Vermont Agency of Natural Resources and the New Hampshire Department of Environmental Services request this study. The requestors are state natural resource agencies.

Existing Information
The PAD references several studies pertaining to shoreline erosion within the Connecticut River, including the study by US Army Corp of Engineers (Simion et al. 1979). This study evaluated the shoreline within the Wilder impoundment and identified water level fluctuation and periodic high flow events as causes of shoreline erosion. The PAD also discusses the erosion survey that TransCanada initiated 2010 to inventory sites where erosion is occurring within the Bellows Falls impoundment (Kleinschmidt 2011). Bank slumping can occur when fluvial erosional forces act on the toe of the bank slope. The PAD did not address how project related operations

contribute to shoreline erosion, could be changed to mitigate impacts on shoreline erosion, or discuss the impacts of shoreline erosion on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.).

Repetitive water level fluctuations and flow alterations caused by hydroelectric peaking operations are known to be a major contributor to shoreline erosion (Lawson 1985). Sediment from shoreline erosion and riverbank failure is one of the major contributors negatively affecting water quality and habitat by increasing turbidity and sedimentation, smothering aquatic habitat in the United States. Vermont Surface Water Management Strategy identifies sediment from excessive channel erosion as a stressor on Vermont water and aquatic habitat. Additionally, Vermont lists this section of the Connecticut River on the Vermont Section 303(d) impaired water list due to flow alterations resulting from the destabilization and eroding of shoreline impairing aquatic life and habitat.

An example of the water level fluctuations that occur in Lower Connecticut River due to hydropower generation is shown below.



Project Nexus

Bellows Falls Hydroelectric Project operations currently result in daily water level fluctuation in the impoundment by approximately 2 feet, which affects shoreline erosion in the impoundment by increasing the rate of soil piping. The project is currently permitted to water level fluctuation in the impoundment by 3 feet. Additionally the project “peaking” operation could contribute to bank erosion downstream of the dam by increasing the shear stress on the bank toe. Furthermore, river profile operations during high flow events the project impoundment is operated to minimize overland flow by drawing down impoundment prior to high flows containing high velocity flows to the river channel, possibly increasing shoreline erosion rate within the impoundment. TransCanada is not proposing any changes to project operations.

Proposed Methodology
Kleinschmidt (2011) conducted a shoreline erosion survey on the Connecticut River, from which we have data on the spatial locations, lengths and heights of such erosion. However, this study did not investigate whether the practice of flow modification is a causative agent to this erosion. Consequently, the Vermont Agency of Natural Resources and the New Hampshire Department of Environmental Services recommend TransCanada further investigate sites on the Connecticut River to evaluate the processes that are active along banks. This investigation should build on the erosion survey that was previously completed by determining the process causing erosion at a site, the extent erosion is negatively affecting other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.), and determining how erosion could be stabilized or mitigated by changing project operations. This investigation can be completed performing the following tasks.

Task 1: Determine erosion and riverbank failure process at identified sites

Shoreline erosion areas and riverbank failure sites were identified during the Kleinschmidt (2011) survey. A survey similar to Kleinschmidt (2011) should be conducted to document if any additional erosion has occurred, and identify new sites of erosion within the impoundment, given the occurrence of Tropical Storm Irene since the Kleinschmidt survey. For each erosion site, the following erosion process element will be identified by determining soil type and subsoil characteristics (i.e. depth to bedrock, texture, rock content, signs of soil piping), reservoir water levels at the time of observation, water level fluctuation, climatic conditions, ground water seepage, wind-driven waves, boat waves, and recreation. Additional site characteristic to identify and record in the erosion survey will include but not be limited to an estimate of the length and average height of the erosional area, slope of the site, dominant vegetation cover types present, associated vegetation cover types present, an ocular estimate of total plant cover and total cover by plant class (tree, shrub, herbaceous) in surrounding undisturbed areas. Data from each shoreline erosion site will be recorded on a field form and entered into a database. In addition, a photograph or photographs will be taken of each site. Sites should be visited when water levels are lowest.

Erosion processes will be determined by field observations and applying site appropriate geology, geomorphic and hydrological principles. To evaluate the relative influence of water level fluctuations on existing shoreline erosion, a minimum of six select sites (three in the impoundment and three downstream of the dam) will be identified for more detailed measurements and observations. In aid of site selection, comparison of successive aerial photographs will be conducted to identify sites that have experienced visible bank movement. Data from erosion surveys will be examined to identify sites with varying conditions of riparian buffer, vegetation type and bank slope. The sites selected for detailed evaluation will represent different combinations of bank movement, riparian buffer, vegetation type and bank slope. In those bank sites that are selected, rebar pins will be inserted into the banks in a grid at varying heights with each rebar being horizontally level.   Initial rebar pin installation will take place when the water level in the impoundment is at its authorized lowest elevation. Each rebar pin will be assigned an individual number and photographed, with the distance from the end of the pin to the bank material measured. A survey will also be conducted of each bank along several bank transects in the immediate vicinity of each site to accurately document bank shape as well as the location and elevation of each rebar and the water surface elevation at the beginning and end of each site visit. Pressure transducers (one in the air and one in the water) will also be installed at each site to automatically record how water surface elevation at each site varies with time.

Biweekly for a period of one year, each of the six sites will be revisited. During each revisit, the bank and each rebar pin will be photographed and the distance from the end of the pin to the bank material will be measured. Any slumping of a pin will be noted. If a pin is found dislodged or removed during a site visit, a new rebar pin will be reinstalled in the approximate location of the previously existing pin.. In addition, a survey of the bank and rebars will be conducted as described above. Surveys will be conducted in the same manner and will use the same benchmark each site visit. Data from pressure transducers will be downloaded and analyzed each site visit to ensure they are working properly. When this dataset is related to the flow record from existing stream gauges in the river segment, this evaluation will allow for a determination as to whether the erosion is Project related, and if so, how Project operations may be impacting the sites.

Task 2: Determining the effects of erosion on other resources

The effects of shoreline erosion and riverbank failure on other resources should be determined. This will required coordination between studies to determine the effects of erosion on riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, and recreation. Erosion sites identified as having an impact on resources will be assess to determine if project operations are causing erosion and a mitigation plan to protect the resource of interest should be developed.

Task 3: Development of a Shoreline Management Plan

The information that is collected during the study should be used to develop a Shoreline Management Plan for the impoundment. If results from the erosion evaluation suggest that Project operations are impacting erosion within the impoundment, further evaluation should be undertaken to determine if there is a feasible way to reduce impacts. This feasibility analysis will be based on field observations and knowledge of current erosion control and slope failure stabilization methods that may be suitable for sites. The analysis will provide a preliminary list of potential control measures necessary to reduce erosion at these sites. Detailed analyses for final design and construction of erosion and slope stabilization control measures will not be part of the study. As part of this process, the landowner should be identified for each of the erosion sites and future mitigation and stabilization techniques should be presented.

The study area for the shoreline erosion study should extend from the upstream end of the impoundment above the Bellows Falls Dam to the beginning of the Vernon impoundment. Water level fluctuations caused by the Project may affect not only the impoundment but also the downstream river reaches below the dam.

Level of Effort and Cost

The cost and effort of this study will be moderate, but is important to document the potential impact project operations on shoreline erosion and riverbank failure, and to determine how this may impact other resources.

Literature Cited

Kleinschmidt (Kleinschmidt Associates, Inc.). 2011. Lower Connecticut River Shoreline Survey Report – 2010: Bellows Falls Project (FERC No. 1855), Wilder Project (FERC No. 1892), Vernon Project (FERC No. 1904). Draft Report March 2011. Prepared for TransCanada Hydro Northeast Inc., Westborough, MA.

Lawson, D.E., 1985, Erosion of northern reservoir shores: An analysis and application of pertinent literature: US Army Corps of Engineers Cold Regions Research and Engineering Laboratory Monograph 85-1, 198 p.

Simons, D.B., Andrews, J.W., Li, R.M., and Alawady, M.A. 1979. Connecticut River Streambank Erosion Study Massachusetts, New Hampshire, and Vermont. Prepared for USACE, New England Division.

Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 1: Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations

Goals and Objectives
The goal of this study is to determine how project operations contribute to the shoreline erosion and riverbank failure within the impoundment and downstream of the Vernon Hydroelectric Project.

The objectives of this study are to:
1. determine how water level fluctuations within the minimum and maximum operating range and discharges from peaking operations at the Wilder hydroelectric project contribute to shoreline erosion;
2. identify and determine the effects of shoreline bank erosion and riverbank failure on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.);
3. identify techniques that could be used to mitigate the effects of project operations or other mitigation techniques that could be developed to reduce on riverbank erosion within the impoundment and downstream of the tailrace.

Resource Management Goals
The Connecticut River is considered Class B water by the states of Vermont and New Hampshire. Vermont lists the section of the Connecticut River above and below Vernon dam on the Section 303(d) impaired water list due to flow alterations resulting in the destabilization and eroding of shoreline impairing aquatic life and habitat. In Class B waters, Vermont's water quality standards state that water level fluctuation and flow alterations can only occur to the extent that it supports all uses and does not lead to degradation of the water resource or habitat. New Hampshire's surface water quality regulations state that "unless the flows are caused by naturally occurring conditions, surface water quantity shall be maintained at levels adequate to protect existing and designated uses." (Env-Wq 1703.01(d)). The specific New Hampshire water quality criteria for turbidity in Class B waters is not to exceed naturally occurring conditions by more than 10 NTUs (Env-Wq 1703.11).

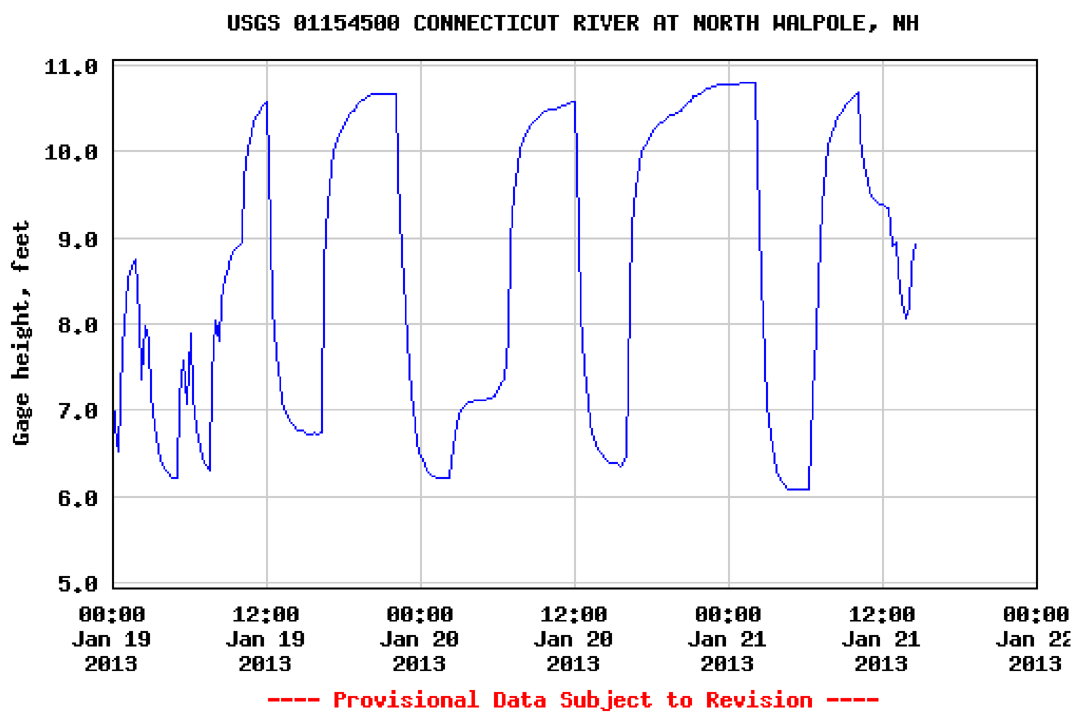
Public Interest Consideration
The Vermont Agency of Natural Resources and the New Hampshire Department of Environmental Services request this study. The requestors are state natural resource agencies.

Existing Information
The PAD references several studies pertaining to shoreline erosion within the Connecticut River, including the study by US Army Corp of Engineers (Simion et al. 1979). This study evaluated the shoreline within the Wilder impoundment and identified water level fluctuation and periodic high flow events as causes of shoreline erosion. The PAD also discusses the erosion survey that TransCanada initiated 2010 to inventory sites where erosion is occurring within the Vernon impoundment (Kleinschmidt 2011). Bank slumping can occur when fluvial erosional forces act on the toe of the bank slope. The PAD did not address how project related operations contribute

to shoreline erosion, could be changed to mitigate impacts on shoreline erosion, or discuss the impacts of shoreline erosion on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.).

Repetitive water level fluctuations and flow alterations caused by hydroelectric peaking operations are known to be a major contributor to shoreline erosion (Lawson 1985). Sediment from shoreline erosion and riverbank failure is one of the major contributors negatively affecting water quality and habitat by increasing turbidity and sedimentation, smothering aquatic habitat in the United States. Vermont Surface Water Management Strategy identifies sediment from excessive channel erosion as a stressor on Vermont water and aquatic habitat. Additionally, Vermont lists this section of the Connecticut River on the Vermont Section 303(d) impaired water list due to flow alterations resulting from the destabilization and eroding of shoreline impairing aquatic life and habitat.

An example of the water level fluctuations that occur in Lower Connecticut River due to hydropower generation is shown below.



Project Nexus

Vernon Hydroelectric Project operations currently result in daily water level fluctuation in the impoundment by approximately 2 feet, which affects shoreline erosion in the impoundment by increasing the rate of soil piping. The project is currently permitted to water level fluctuation in the impoundment by 8 feet. Additionally the project “peaking” operation could contribute to bank erosion downstream of the dam by increasing the shear stress on the bank toe. TransCanada is not proposing any changes to project operations.

Proposed Methodology

Kleinschmidt (2011) conducted a shoreline erosion survey on the Connecticut River, from which we have data on the spatial locations, lengths and heights of such erosion. However, this study did not investigate whether the practice of flow modification is a causative agent to this erosion. Consequently, the Vermont Agency of Natural Resources and the New Hampshire Department of Environmental Services recommend TransCanada further investigate sites on the Connecticut River to evaluate the processes that are active along banks. This investigation should build on the erosion survey that was previously completed by determining the process causing erosion at a site, the extent erosion is negatively affecting other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.), and determining how erosion could be stabilized or mitigated by changing project operations. This investigation can be completed performing the following tasks.

Task 1: Determine erosion and riverbank failure process at identified sites

Shoreline erosion areas and riverbank failure sites were identified during the Kleinschmidt (2011) survey. A survey similar to Kleinschmidt (2011) should be conducted to document if any additional erosion has occurred, and identify new sites of erosion within the impoundment, given the occurrence of Tropical Storm Irene since the Kleinschmidt survey. For each erosion site, the following erosion process element will be identified by determining soil type and subsoil characteristics (i.e. depth to bedrock, texture, rock content, signs of soil piping), reservoir water levels at the time of observation, water level fluctuation, climatic conditions, ground water seepage, wind-driven waves, boat waves, and recreation. Additional site characteristic to identify and record in the erosion survey will include but not be limited to an estimate of the length and average height of the erosional area, slope of the site, dominant vegetation cover types present, associated vegetation cover types present, an ocular estimate of total plant cover and total cover by plant class (tree, shrub, herbaceous) in surrounding undisturbed areas. Data from each shoreline erosion site will be recorded on a field form and entered into a database. In addition, a photograph or photographs will be taken of each site. Sites. should be visited when water levels are lowest.

Erosion processes will be determined by field observations and applying site appropriate geology, geomorphic and hydrological principles. To evaluate the relative influence of water level fluctuations on existing shoreline erosion, a minimum of six select sites (three in the impoundment and three downstream of the dam) will be identified for more detailed measurements and observations. In aid of site selection, comparison of successive aerial photographs will be conducted to identify sites that have experienced visible bank movement. Data from erosion surveys will be examined to identify sites with varying conditions of riparian buffer, vegetation type and bank slope. The sites selected for detailed evaluation will represent different combinations of bank movement, riparian buffer, vegetation type and bank slope. In those bank sites that are selected, rebar pins will be inserted into the banks in a grid at varying heights with each rebar being horizontally level. Initial rebar pin installation will take place when the water level in the impoundment is at its authorized lowest elevation. Each rebar pin will be assigned an individual number and photographed, with the distance from the end of the pin to the bank material measured. A survey will also be conducted of each bank along several bank transects in the immediate vicinity of each site to accurately document bank shape as well as the location and elevation of each rebar and the water surface elevation at the beginning and end of each site visit. Pressure transducers (one in the air and one in the water) will also be installed at each site to automatically record how water surface elevation at each site varies with time.

Biweekly for a period of one year, each of the six sites will be revisited. During each revisit, the bank and each rebar pin will be photographed and the distance from the end of the pin to the bank material will be measured. Any slumping of a pin will be noted. If a pin is found dislodged or removed during a site visit, a new rebar pin will be reinstalled in the approximate location of the previously existing pin.. In addition, a survey of the bank and rebars will be conducted as described above. Surveys will be conducted in the same manner and will use the same benchmark each site visit. Data from pressure transducers will be downloaded and analyzed each site visit to ensure they are working properly. When this dataset is related to the flow record from existing stream gauges in the river segment, this evaluation will allow for a determination as to whether the erosion is Project related, and if so, how Project operations may be impacting the sites.

Task 2: Determining the effects of erosion on other resources

The effects of shoreline erosion and riverbank failure on other resources should be determined. This will required coordination between studies to determine the effects of erosion on riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, and recreation. Erosion sites identified as having an impact on resources will be assess to determine if project operations are causing erosion and a mitigation plan to protect the resource of interest should be developed.

Task 3: Development of a Shoreline Management Plan

The information that is collected during the study should be used to develop a Shoreline Management Plan for the impoundment. If results from the erosion evaluation suggest that Project operations are impacting erosion within the impoundment, further evaluation should be undertaken to determine if there is a feasible way to reduce impacts. This feasibility analysis will be based on field observations and knowledge of current erosion control and slope failure stabilization methods that may be suitable for sites. The analysis will provide a preliminary list of potential control measures necessary to reduce erosion at these sites. Detailed analyses for final design and construction of erosion and slope stabilization control measures will not be part of the study. As part of this process, the landowner should be identified for each of the erosion sites and future mitigation and stabilization techniques should be presented.

The study area for the shoreline erosion study should extend from the upstream end of the impoundment above the Vernon Dam to the beginning of the Turner Falls impoundment. Water level fluctuations caused by the Project may affect not only the impoundment but also the downstream river reaches below the dam.

Level of Effort and Cost
The cost and effort of this study will be moderate, but is important to document the potential impact project operations on shoreline erosion and riverbank failure, and to determine how this may impact other resources.

Literature Cited

Kleinschmidt (Kleinschmidt Associates, Inc.). 2011. Lower Connecticut River Shoreline Survey Report – 2010: Bellows Falls Project (FERC No. 1855), Wilder Project (FERC No. 1892), Vernon Project (FERC No. 1904). Draft Report March 2011. Prepared for TransCanada Hydro Northeast Inc., Westborough, MA.

Lawson, D.E., 1985, Erosion of northern reservoir shores: An analysis and application of pertinent literature: US Army Corps of Engineers Cold Regions Research and Engineering Laboratory Monograph 85-1, 198 p.

Simons, D.B., Andrews, J.W., Li, R.M., and Alawady, M.A. 1979. Connecticut River Streambank Erosion Study Massachusetts, New Hampshire, and Vermont. Prepared for USACE, New England Division.

Turners Falls Hydroelectric Project – FERC No. 1889-081
Northfield Mountain Pumped Storage Project – FERC No. 2485-063

Study Request 1: Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations

Goals and Objectives
The goal of this study is to determine how project operations contribute to the shoreline erosion and riverbank failure within the impoundment and downstream of the Turner Falls/Northfield Mountain projects.

The objectives of this study are to:

1. determine how water level fluctuations within the minimum and maximum operating range and discharges from peaking operations at the Turner Falls/Northfield Pump Station hydroelectric project contribute to shoreline erosion;
2. identify and determine the effects of shoreline bank erosion and riverbank failure on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.);
3. identify techniques that could be used to mitigate the effects of project operations or other mitigation techniques that could be developed to reduce on riverbank erosion within the impoundment and downstream of the tailrace.

Resource Management Goals
The Connecticut River is considered Class B water by the states of Vermont. Vermont lists the section of the Connecticut River below the Wilder dam on the Section 303(d) impaired water list due to flow alterations resulting in the destabilization and eroding of shoreline impairing aquatic life and habitat. In Class B waters, Vermont's water quality standards state that water level fluctuation and flow alterations can only occur to the extent that it supports all uses and does not lead to degradation of the water resource or habitat.

Public Interest Consideration
The requestor is a state natural resource agency.

Existing Information
The PAD makes reference to several studies in section 4.2.4 including the Erosion Control Plan (Simons & Associates, 1999), previous Full River Reconnaissance studies (1998, 2001 – maps but no report generated, 2004, and 2008), Field Geology Services' 2007 fluvial geomorphic investigation of the Turners Fall headpond, and 2012 investigations by Simons & Associates.

Field Geology Services' 2007 investigation provided several good recommendations for future work in section 9.3 of his report which, if implemented, could provide for: a) an improved understanding of the causes of erosion; b) more accurate monitoring of erosion; and c) more successful bank stabilization efforts. This document is a good point of reference. The Simons & Associates' (2012) documents are qualitative and based on several unstated assumptions that may not be valid. Full River Reconnaissance efforts have been undertaken using varying methodologies, making for difficult comparisons from one report to the other.

We believe that these existing studies do have data that can be useful if certain new analyses are undertaken. These analyses of existing data would help fill in our gaps of understanding of bank erosion in the Turners Fall headpond. We are also asking for some additional field collected data. With the existing information, it should be possible to better display what changes have occurred to streambanks over time. Current Geographic Information System (GIS) software allows for various types of data to be assembled into a map and into a database such that change over time analysis can be conducted fairly easily. The change over time analysis is a critical analysis that is needed, and was already started under Field (2007).

Photos that have been taken at or near the same location but at different times exist. For example, the last three Full River Reconnaissance efforts have included continuous videotaping of the river banks with locational information. With these data, "snapshots" of the bank at various locations could be extracted and compared over time. Field (2007) photo locations could be re-shot as well. This existing information should be presented such that it is easy to discern where the photo was taken and what changes have occurred over time. A comparison of the bank every 100 ft could be compared over the years.
Historic aerial photography for the Turners Fall headpond should be gathered and analyzed. Examples of good photographic datasets include the Field 2007 appendices and 1929 aerials. The location of the shoreline over time should be noted such that it is easy to discern where bank retreat has been most severe and where the river has been relatively stable since the earliest aerial photograph was taken.

Very little turbidity data for the Turner's Falls headpond, the bypass reach or stretches of the Connecticut River downstream of the Turner's Fall project exist. Thus far, implementation of the *Northfield Mountain Pumped Storage Project Sediment Management Plan* (revised February 15, 2012) has yielded few results, and many technological difficulties (see *2012 Sediment Management Plan – 2012 Summary of Annual Monitoring* dated November 30, 2012). Suspended sediment monitoring equipment is installed at the Route 10 Bridge upstream of the project and inside the powerhouse, theoretically taking readings representative of pumping and discharging through the turbines. An analysis of how turbidity might change relative to rapidly changing headpond levels would be very useful information.

Project Nexus
The construction of the NMPS project was contingent upon the Turner's Falls project raising the dam crest elevation by 5.9 feet which has extended the headpond into Vermont and New Hampshire. The NMPS project operations rely on the Turner's Falls headpond as the source of water to be pumped and to be discharged into. The importance of this river reach to the NMPS operation is made clear by Firstlight's reference to this portion of the river as the "lower reservoir." Daily pumping and discharging changes the ponded elevation of the Connecticut River which in turn leads to bank material that repeatedly becomes saturated and then dewatered. Weakened bank material can then become eroded and the fine grain material from the banks can enter the water column and be transported in suspension in the river and eventually settle onto bed material. The raising of the Turner's Falls headpond also made recreational boating more popular, including the introduction of large, high-horsepower powerboats that were not previously present. Because of the fluctuating water levels, boat wakes impact the shoreline to a much greater extent than would occur if levels were more constant, thus exacerbating both the

effects of the wakes and the fluctuating levels. The requested study will help inform the Agency when contemplating mitigation measures and or operational modifications.

Proposed Methodology
This investigation should build on the erosion survey that was previously completed by determining the process causing erosion at a site, the extent erosion is negatively affecting other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.), and determining how erosion could be stabilized or mitigated by changing project operations. This investigation can be completed performing the following tasks.

Task 1: Determine erosion and riverbank failure process at identified sites

Shoreline erosion areas and riverbank failure sites were identified during the previous surveys. A survey should be conducted to document if any additional erosion has occurred, and identify new sites of erosion within the impoundment. For each erosion site, the following erosion process element will be identified by determining soil type and subsoil characteristics (i.e. depth to bedrock, texture, rock content, signs of soil piping), reservoir water levels at the time of observation, water level fluctuation, climatic conditions, ground water seepage, wind-driven waves, boat waves, and recreation. Additional site characteristic to identify and record in the erosion survey will include but not be limited to an estimate of the length and average height of the erosional area, slope of the site, dominant vegetation cover types present, associated vegetation cover types present, an ocular estimate of total plant cover and total cover by plant class (tree, shrub, herbaceous) in surrounding undisturbed areas. Data from each shoreline erosion site will be recorded on a field form and entered into a database. In addition, a photograph or photographs will be taken of each site. Sites should be visited when water levels are lowest.

Erosion processes will be determined by field observations and applying site appropriate geology, geomorphic and hydrological principles. To evaluate the relative influence of water level fluctuations on existing shoreline erosion, a minimum of six select sites (three in the impoundment and three downstream of the dam) will be identified for more detailed measurements and observations. In aid of site selection, comparison of successive aerial photographs will be conducted to identify sites that have experienced visible bank movement. Data from erosion surveys will be examined to identify sites with varying conditions of riparian buffer, vegetation type and bank slope. The sites selected for detailed evaluation will represent different combinations of bank movement, riparian buffer, vegetation type and bank slope. In those bank sites that are selected, rebar pins will be inserted into the banks in a grid at varying heights with each rebar being horizontally level. Initial rebar pin installation will take place when the water level in the impoundment is at its authorized lowest elevation. Each rebar pin will be assigned an individual number and photographed, with the distance from the end of the pin to the bank material measured. A survey will also be conducted of each bank along several bank transects in the immediate vicinity of each site to accurately document bank shape as well as the location and elevation of each rebar and the water surface elevation at the beginning and end of each site visit. Pressure transducers (one in the air and one in the water) will also be installed at each site to automatically record how water surface elevation at each site varies with time.

Biweekly for a period of one year, each of the six sites will be revisited. During each revisit, the bank and each rebar pin will be photographed and the distance from the end of the pin to the bank material will be measured. Any slumping of a pin will be noted. If a pin is found dislodged or removed during a site visit, a new rebar pin will be reinstalled in the approximate location of the previously existing pin. In addition, a survey of the bank and rebars will be conducted as described above. Surveys will be conducted in the same manner and will use the same benchmark each site visit. Data from pressure transducers will be downloaded and analyzed each site visit to ensure they are working properly. When this dataset is related to the flow record from existing stream gauges in the river segment, this evaluation will allow for a determination as to whether the erosion is Project related, and if so, how Project operations may be impacting the sites.

Task 2: Determining the effects of erosion on other resources

The effects of shoreline erosion and riverbank failure on other resources should be determined. This will required coordination between studies to determine the effects of erosion on riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, and recreation. Erosion sites identified as having an impact on resources will be assess to determine if project operations are causing erosion and a mitigation plan to protect the resource of interest should be developed.

Task 3: Development of a Shoreline Management Plan

The information that is collected during the study should be used to develop a Shoreline Management Plan for the impoundment. If results from the erosion evaluation suggest that Project operations are impacting erosion within the impoundment, further evaluation should be undertaken to determine if there is a feasible way to reduce impacts. This feasibility analysis will be based on field observations and knowledge of current erosion control and slope failure stabilization methods that may be suitable for sites. The analysis will provide a preliminary list of potential control measures necessary to reduce erosion at these sites. Detailed analyses for final design and construction of erosion and slope stabilization control measures will not be part of the study. As part of this process, the landowner should be identified for each of the erosion sites and future mitigation and stabilization techniques should be presented.

Level of Effort and Cost
The cost and effort of this study will be moderate, but is important to document the potential impact project operations on shoreline erosion and riverbank failure, and to determine how this may impact other resources.

Literature Cited

Lawson, D.E., 1985, Erosion of northern reservoir shores: An analysis and application of pertinent literature: US Army Corps of Engineers Cold Regions Research and Engineering Laboratory Monograph 85-1, 198 p.

Simons, D.B., Andrews, J.W., Li, R.M., and Alawady, M.A. 1979. Connecticut River Streambank Erosion Study Massachusetts, New Hampshire, and Vermont. Prepared for USACE, New England Division.

Wilder Hydroelectric Project – FERC No. 1892-026

Study Request 2: Water quality monitoring within the project impoundment and tailrace

Goals and Objectives
The goal of this study is to determine if the operational impacts of the Wilder Hydroelectric Project are causing or contributing to violations of New Hampshire and/or Vermont state water quality standards.

The objective of this study will be to collect water temperature, dissolved oxygen, specific conductance, pH, nutrients, and chlorophyll-a data at multiple locations in the project area. This monitoring effort will consist of both instantaneous measurements and continuous data collected via multi-parameter dataloggers. Data should be collected under normal operating conditions and ambient conditions that include periods of low flow and higher water temperatures. Weekly profiles and grab samples should reflect various flow conditions. The water quality data will be compared to both Vermont and New Hampshire water quality standards to determine if the project is causing or contributing to water quality standard violations.

Resource Management Goals
The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Vermont lists the section of the Connecticut River below the Wilder dam on the Section 303(d) impaired water list due to flow alterations aquatic life and habitat.

All sections of the Connecticut River related to the project are classified by New Hampshire as Class B. It should be noted that although the classification name is the same as Vermont's, New Hampshire surface water criteria for Class B waters, are in some cases, different from Vermont's.

New Hampshire surface water quality standards (Env-Wq 1703.01) state that the surface water quality criteria for all surface waters shall be restored to meet the water quality criteria for their designated classification, including existing and designated uses, and to maintain the chemical, physical, and biological integrity of surface water.

Public Interest Consideration
The Vermont Agency of Natural Resources and the New Hampshire Department of Environmental Services are requesting this study. The requestors are state natural resource agencies.

Existing Information
The PAD contains information on water quality monitoring that was completed between June 20, 2012 and September 11, 2012 in the tailrace and just upstream of the dam. The data indicated that Vermont Water Quality Standards for dissolved oxygen were not met during a seven day period in August. The PAD does not provide information on the water quality throughout the impoundment or how water quality is affected by project operations. The PAD does indicate that

in general temperature, specific conductance, and pH did increase from upstream to downstream while dissolved oxygen decreased, reflecting the impacts of the impoundment.

Project Nexus

The project impounds 45 miles of river that would otherwise be free flowing. It currently operates in a peaking mode, with allowable impoundment fluctuations of up to 5 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (675 cfs). Water quality can be affected by the operating mode of a hydropower project. The PAD provides limited information on how project operations affect water quality within the project impoundment and tailrace.

Operations of the project must conform to Vermont and New Hampshire water quality standards. The Vermont Agency of Natural Resources and the New Hampshire Department of Environmental Services request a study that will provide the data needed to determine if the Connecticut River in the vicinity of the Wilder Hydroelectric Project is or is not attaining the water quality standards of both states.

Proposed Methodology

The methodology for this study should be similar to TransCanada's water quality monitoring in 2012 including weekly vertical profiles within the impoundment, weekly water quality samples of nutrients and chlorophyll-a for laboratory analysis and the deployment of multi-parameter continuous dataloggers at multiple locations within the impoundment and tailrace. An additional site should be monitored in the free flowing section of the river above the impoundment to serve as a "reference site". At each designated datalogger monitoring location at least 10 days of data should be collected at 15 minute increments during a period of low flow ($\leq$3 x 7Q10) and high temperatures (preferably over 23 degrees C) between June 1 and September 30. Dataloggers deployed in the impoundment should be set at the bottom of the epilimnion (if stratified) or at 25% depth if not stratified. A vertical dissolved oxygen and water temperature profile should be conducted at the time of deployment of dataloggers in the impounded section to determine if river is stratified and thus the appropriate depth for deployment. Water quality results should be graphically compared to both state water quality standards and project operations, including the generation status, impoundment elevation, and discharge.

If low flow conditions are not met the first year of the study, a second year of data may be necessary.

It is preferable that the water quality monitoring for all three projects be coordinated so that sampling can occur at each location within each project during the same period of time and under the same operational, flow, and environmental conditions.

Level of Effort and Cost

The cost and effort of this study will be moderate, but is important to document the potential impact operations have on water quality and determine if they meet Vermont and New Hampshire water quality standards.

Bellow Falls Hydroelectric Project – FERC No. 1855-045

Study Request 2: Water quality monitoring within the project impoundment, bypass, and tailrace

Goals and Objectives

The goal of this study is to determine if the operational impacts of the Bellows Falls Hydroelectric Project are causing or contributing to violations of New Hampshire and/or Vermont state water quality standards.

The objective of this study will be to collect water temperature, dissolved oxygen, specific conductance, pH, nutrients, and chlorophyll-a data at multiple locations in the project area. This monitoring effort will consist of both instantaneous measurements and continuous data collected via multi-parameter dataloggers. Data should be collected under normal operating conditions and ambient conditions that include periods of low flow and higher water temperatures. Weekly profiles and grab samples should reflect various flow conditions. The water quality data will be compared to both Vermont and New Hampshire water quality standards to determine if the project is causing or contributing to water quality standard violations.

Resource Management Goals

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Vermont list the section of the Connecticut River above and below Bellows Falls dam on the Section 303(d) impaired water list due to flow alterations impairing aquatic life and habitat.

All sections of the Connecticut River related to the project are classified by New Hampshire as Class B. It should be noted that although the classification name is the same as Vermont's, New Hampshire surface water criteria for Class B waters, are in some cases, different from Vermont's.

New Hampshire surface water quality standards (Env-Wq 1703.01) state that the surface water quality criteria for all surface waters shall be restored to meet the water quality criteria for their designated classification, including existing and designated uses, and to maintain the chemical, physical, and biological integrity of surface water.

Public Interest Consideration

The Vermont Agency of Natural Resources and the New Hampshire Department of Environmental Services are requesting this study. The requestors are state natural resource agencies.

Existing Information

The PAD contains information on water quality monitoring that was completed between June 20, 2012 and September 12, 2012 in the tailrace, bypass reach and just upstream of the dam. Additionally, weekly water column profiles were collected at three locations within the impoundment. The data indicated that Vermont and New Hampshire water quality standards for dissolved oxygen were not met in the bypass reach and in the impoundment. Furthermore, pH readings collected in water profile measurements indicated that in two different locations during two separate events in the impoundment did not meet Vermont and New Hampshire water quality standards. The PAD does not provide information on the continuous water quality throughout the impoundment or how water quality is affected by project operations. The PAD indicates that in general temperature, specific conductance, and pH did increase from upstream to downstream while dissolved oxygen decreased, reflecting the impacts of the impoundment.

Project Nexus

The project impounds 26 miles of river that would otherwise be free flowing. It currently operates in a peaking mode, with allowable impoundment fluctuations of up to 3 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1083 cfs). Water quality can be affected by the operating mode of a hydropower project. The PAD provides limited information on how project operations affect water quality within the project impoundment, bypass reach and tailrace.

Operations of the project must conform to Vermont and New Hampshire water quality standards. The Vermont Agency of Natural Resources and the New Hampshire Department of Environmental Services request a study that will provide the data needed to determine if the Connecticut River in the vicinity of the Wilder Hydroelectric Project is or is not attaining the water quality standards of both states.

Proposed Methodology

The methodology for this study should be similar to TransCanada's water quality monitoring in 2012 including weekly vertical profiles within the impoundment, weekly water quality samples of nutrients and chlorophyll-a for laboratory analysis and the deployment of multi-parameter continuous dataloggers at multiple locations within the impoundment, the bypass reach, and tailrace. An additional site should be monitored in the 17 mile free flowing section of the river above the impoundment to serve as a "reference site". At each designated datalogger monitoring location at least 10 days of data should be collected at 15 minute increments during a period of low flow (≤3 x 7Q10) and high temperatures (preferably over 23 degrees C) between June 1 and September 30. Dataloggers deployed in the impoundment should be set at the bottom of the epilimnion (if stratified) or at 25% depth if not stratified. A vertical dissolved oxygen and water temperature profile should be conducted at the time of deployment of dataloggers in the impounded section to determine if river is stratified and thus the appropriate depth for deployment. Water quality results should be graphically compared to both state water quality standards and project operations, including the generation status, impoundment elevation, and discharge.

If low flow conditions are not met the first year of the study, a second year of data may be necessary.

It is preferable that the water quality monitoring for all three projects be coordinated so that sampling can occur at each location within each project during the same period of time and under the same operational, flow, and environmental conditions.

Level of Effort and Cost

The cost and effort of this study will be moderate, but is important to document the potential impact operations have on water quality and determine if they meet Vermont and New Hampshire water quality standards.

Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 2: Water quality monitoring within the project impoundment and tailrace

Goals and Objectives

The goal of this study is to determine if the operational impacts of at the Vernon Hydroelectric Project are causing or contributing to violations of New Hampshire and/or Vermont state water quality standards.

The objective of this study will be to collect water temperature, dissolved oxygen, specific conductance, pH, nutrients, and chlorophyll-a data at multiple locations in the project area. This monitoring effort will consist of both instantaneous measurements and continuous data collected via multi-parameter dataloggers. Data should be collected under normal operating conditions and ambient conditions that include periods of low flow and higher water temperatures. Weekly profiles and grab samples should reflect various flow conditions. The water quality data will be compared to both Vermont and New Hampshire water quality standards to determine if the project is causing or contributing to water quality standard violations.

Resource Management Goals

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Vermont lists the section of the Connecticut River above and below Vernon dam on the Section 303(d) impaired water list due to flow alterations impairing aquatic life and habitat.

All sections of the Connecticut River related to the project are classified by New Hampshire as Class B. It should be noted that although the classification name is the same as Vermont's, New Hampshire surface water criteria for Class B waters, are in some cases, different from Vermont's.

New Hampshire surface water quality standards (Env-Wq 1703.01) state that the surface water quality criteria for all surface waters shall be restored to meet the water quality criteria for their designated classification, including existing and designated uses, and to maintain the chemical, physical, and biological integrity of surface water.

Public Interest Consideration

The Vermont Agency of Natural Resources and the New Hampshire Department of Environmental Services are requesting this study. The requestors are state natural resource agencies.

Existing Information

The PAD contains information on water quality monitoring that was completed between June 20, 2012 and September 11, 2012 in the tailrace and just upstream of the dam. Temperature data indicated that it reached levels that would be critical threshold for salmonids, and above the natural regime for the river. The PAD does not provide information on the water quality throughout the impoundment or how water quality is affected by project operations. The PAD does indicates that in general temperature, specific conductance, and pH did increase from upstream to downstream while dissolved oxygen decreased, reflecting the impacts of the impoundment on increase travel time in the river.

Project Nexus

The project impounds 26 miles of river that would otherwise be natural free-flowing. It currently operates in a peaking mode, with allowable impoundment fluctuations of up to 8 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1250 cfs). Water quality can be affected by the operating mode of a hydropower project. The PAD provides limited information on how project operations affect water quality within the project impoundment and tailrace.

Operations of the project must conform to Vermont and New Hampshire water quality standards . The Vermont Agency of Natural Resources and the New Hampshire Department of Environmental Services request a study that will provide the data needed to determine if the Connecticut River in the vicinity of the Wilder Hydroelectric Project is or is not attaining the water quality standards of both states.

Proposed Methodology

The methodology for this study should be similar to TransCanada's water quality monitoring in 2012 including weekly vertical profiles within the impoundment, weekly water quality samples of nutrients and chlorophyll-a for laboratory analysis and the deployment of multi-parameter continuous dataloggers at multiple locations within the impoundment and tailrace. An additional site should be monitored in the free flowing section of the river above the impoundment to serve as a "reference site". At each designated datalogger monitoring location at least 10 days of data should be collected at 15 minute increments during a period of low flow (≤3 x 7Q10) and high temperatures (preferably over 23 degrees C) between June 1 and September 30. Dataloggers deployed in the impoundment should be set at the bottom of the epilimnion (if stratified) or at 25% depth if not stratified. A vertical dissolved oxygen and water temperature profile should be conducted at the time of deployment of dataloggers in the impounded section to determine if river is stratified and thus the appropriate depth for deployment. Water quality results should be graphically compared to both state water quality standards and project operations, including the generation status, impoundment elevation, and discharge.

If low flow conditions are not met the first year of the study, a second year of data may be necessary.

It is preferable that the water quality monitoring for all three projects be coordinated so that sampling can occur at each location within each project during the same period of time and under the same operational, flow, and environmental conditions.

Level of Effort and Cost

The cost and effort of this study will be moderate, but is important to document the potential impact project operations have on water quality and determine if they meet Vermont and New Hampshire water quality standards.

Turners Falls Hydroelectric Project – FERC No. 1889-081
Northfield Mountain Pumped Storage Project – FERC No. 2485-063

Study Request 2: Water quality monitoring within the project impoundment and tailrace

Goals and Objectives
The goal of this study is to determine if the operational impacts of at the Turner Falls Project are causing or contributing to violations of New Hampshire and/or Vermont state water quality standards.

The objective of this study will be to collect water temperature, dissolved oxygen, specific conductance, pH, nutrients, and chlorophyll-a data at multiple locations in the project area. This monitoring effort will consist of both instantaneous measurements and continuous data collected via multi-parameter dataloggers. Data should be collected under normal operating conditions and ambient conditions that include periods of low flow and higher water temperatures. Weekly profiles and grab samples should reflect various flow conditions. The water quality data will be compared to both Vermont and New Hampshire water quality standards to determine if the project is causing or contributing to water quality standard violations.

Resource Management Goals
The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Vermont lists the section of the Connecticut River below Vernon dam on the Section 303(d) impaired water list due to flow alterations impairing aquatic life and habitat.

Public Interest Consideration
The requestor is a state natural resource agency.

Existing Information
The PAD provides a summary of existing water quality data. While a number of monitoring efforts have taken place and include sample sites within the project boundary, none of those studies were designed to comprehensively investigate whether all relevant project areas currently meet Class B standards, and no data was collected in the section of the impoundment between Vermont and New Hampshire: The Massachusetts DEP's Connecticut River watershed assessment monitoring occurred in 2003, only had two stations located within the project area (both upstream of the Turners Falls dam) and only collected five to six samples from late April to early October; the Connecticut River Watershed Council's volunteer monitoring program only had one sample site within the project area (at Barton's Cove in the Turners Falls headpond) and while those data are more recent, only three samples were collected in 2007 and only six samples in 2008 (over the course of three to four months each year); and the U.S. Geological Survey's long-term water quality monitoring station located downstream of the Cabot Station tailrace only collects information roughly once per month (and no dissolved oxygen data are provided).

No directed, site-specific surveys have been conducted to determine whether waters within the Project area in Vermont and New Hampshire meet State standards. This information gap needs to be filled so that resource agencies can evaluate properly the potential impact of project operations on water quality.

Project Nexus

The project creates a 20-mile-long impoundment where there would naturally be a free-flowing river with 5.7 miles between Vermont and New Hampshire. It currently operates in a peaking mode, with allowable headpond fluctuations of up to 9 feet, with proposals to continue as such. Portions of the headpond are nearly 100 feet-deep. There is a 2.7 mile-long reach of river bypassed by the Turners Falls power canal with only a nominal seasonal release required (equal to 0.05 cfsm). The below-project flow requirement is equal to 0.20 cfsm (1,433 cfs). Water quality can be affected by the operating mode of a hydropower project. Impoundments can stratify, resulting in a near-hypoxic hypolimnion. If the project intake draws off of these deep waters then it could cause low dissolved oxygen levels downstream from the project discharge.

The Vermont Agency of Natural Resources requests that the applicant conduct a water quality survey of the impoundment reach within Vermont in order to determine whether state water quality standards are being met under all currently-licensed operating conditions (i.e., during periods of generation and non-generation). Results of the survey would be used, in conjunction with other studies requested herein, to determine an appropriate below-Project flow prescription, bypass reach flow(s), and to recommend an appropriate water level management protocol for the headpond (e.g., limiting impoundment fluctuations to protect water quality).

Operation of upstream hydroelectric projects as well as the Turners Falls Project and Northfield Mountain Project may impact water quality through the use of water for hydropower generation.

Proposed Methodology

The methodology for this study should include weekly vertical profiles within the impoundment, weekly water quality samples of nutrients and chlorophyll-a for laboratory analysis and the deployment of multi-parameter continuous dataloggers at multiple locations within the impoundment. An additional site should be monitored in the free flowing section of the river above the impoundment to serve as a “reference site”. At each designated datalogger monitoring location at least 10 days of data should be collected at 15 minute increments during a period of low flow ($\leq$3 x 7Q10) and high temperatures (preferably over 23 degrees C) between June 1 and September 30. Dataloggers deployed in the impoundment should be set at the bottom of the epilimnion (if stratified) or at 25% depth if not stratified. A vertical dissolved oxygen and water temperature profile should be conducted at the time of deployment of dataloggers in the impounded section to determine if river is stratified and thus the appropriate depth for deployment. Water quality results should be graphically compared to both state water quality standards and project operations, including the generation status, impoundment elevation, and discharge.

If low flow conditions are not met the first year of the study, a second year of data may be necessary.

It is preferable that the water quality monitoring be coordinated with TransCanada so that sampling can occur at each location within each project during the same period of time and under the same operational, flow, and environmental conditions.

Level of Effort and Cost

The cost and effort of this study will be moderate, but is important to document the potential impact project operations have on water quality and determine if they meet Vermont water quality standards.

Wilder Hydroelectric Project – FERC No. 1892-026

Study Request 3: Continuous water temperature monitoring at various locations within the impoundment and tailrace, and downstream Connecticut River

Goals and Objectives

The goal of this study is to determine the potential impacts (both project specific and cumulative) of the Wilder Hydroelectric Project operations on hourly/daily temperature fluctuations and spatial thermal distribution within the Wilder Hydroelectric Project Impoundment and Tailrace**,** and the Connecticut River downstream of the Wilder Dam.

The objectives of this study are to:

1. Obtain continuous temperature data (every 15 minutes) at various locations and depths throughout the project impoundment, tailrace, and downstream Connecticut River using temperature loggers;

2. Analyze data for hourly/daily shifts in temperature regime and thermal distribution (aquatic isotherm maps) associated project specific and cumulative impacts associated with project operations; and

3. Determine if any shifts in hourly temperature regime or thermal distribution are impacting aquatic habitat within the project impoundment and tailrace and lower Connecticut River (e.g., thermal blocks to migration, thermal stress, habitat degradation).

Resource Management Goals

Temperature is an important habitat consideration for many aquatic species including migratory fish and rare, threatened, endangered species. Temperature influences the distribution, behavior, metabolism, growth, reproduction, and survival of fishes (Diana 2004). The Connecticut River is considered a Class B waters cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Additionally the Vermont Water Quality Standards states that in Class B cold water fish habitat, the total increase in from any activity or discharge should not result in a temperature increase that exceeds 1.0°F.

Public Interest Consideration

The requestor is a state natural resource agency.

Existing Information

The PAD provides limited information on impacts of project operations ("daily run-of-river") on temperature in the project impoundment, tailrace or lower Connecticut River. Hourly/daily temperature shifts associated with project operations at Wilder Dam can impact aquatic habitat rendering it unsuitable for some organisms. The information in the PAD does not define the spatial extent of temperatures (aquatic isotherm map) within the impoundment, lower Connecticut River. The PAD mainly indicates that in general, temperature did increase from

upstream to downstream while dissolved oxygen decreased, reflecting the impacts of the impoundment.

Project Nexus

The project impounds 45 miles of river that would otherwise be free flowing. It currently operates in a peaking mode, with allowable impoundment fluctuations of up to 5 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (675 cfs). Water temperature can be affected by the operating mode of a hydropower project. The impounded water increases the water surface area of the river reach containing the project. The increased surface acts as a large solar radiation collector and the thermal mass of the impounded water acts a heat sink storing heat from solar radiation. At night the increased surface area may act as convective radiator that releases heat. Together these attributes may contribute to unnatural thermal properties in the project impoundment that may impact natural temperature regime and influence habitat conditions for fish, wildlife and plant resources (temperature tolerance, life cycle timing (e.g., reproduction or migration), and food availability).

The project discharges regulated Connecticut River flows ("daily run-of-river") from the impoundment to the downstream seventeen mile reach of the Connecticut River. The project can sporadically release large volumes of impoundment water that may be of a different temperature than the receiving water downstream of the dam. Unnatural and rapid shifts in temperature regimes in the downstream water can impact fish, wildlife and plant resources and instream habitat. The Agency requests that more recent temperature data is collected in a more intensive, systematic and scientific manner in order to assess project specific and cumulative impacts on fish, wildlife and plant resources at the project. Results from this study may be used to directly inform the evaluation of project effects on related resources, such as a fish and other aquatic species.

Proposed Methodology

Use of temperature loggers to gain information on thermal trends has been a standard technique to look at impacts of water storage associated with hydroelectric projects. We recommend that transects be established in the upper, middle, and lower project impoundment, as well as in the tailrace and downstream project. An additional transect should be established in the free flowing section of river above the impoundment to serve as a "reference site". Inexpensive temperature loggers should be deployed along each transects at a minimum of three locations: at depths of 1 meter subsurface, mid-depth, and 1 meter off the bottom (on buoy lines) where water depths permit. The temperature loggers should be deployed from April 1 – November 15 and be set to record temperature at 15 minute intervals. The temperature loggers should be checked and the data downloaded on the monthly basis. The data from the loggers should then be used to develop hourly/daily aquatic isotherm maps, and temperature change and distribution as a result of project and cumulative impacts should be assessed.

Level of Effort and Cost

The effort and cost of this study is expected to be moderate to high, but the potential project specific and cumulative thermal alteration impacts have never been studied in a comprehensive manner and their potential impacts to aquatic habitat and fish, wildlife, and resources has not been adequately studied.

Literature Cited

Diana, J.S. 2004. Biology and Ecology of Fishes. 2nd edition. Biological Sciences Press.

Bellows Falls Hydroelectric Project – FERC No. 1855-045

Study Request 3: Continuous water temperature monitoring at various locations within the impoundment and tailrace, and downstream Connecticut River

Goals and Objectives

The goal of this study is to determine the potential impacts (both project specific and cumulative) of the Bellows Falls Hydroelectric Project operations on hourly/daily temperature fluctuations and spatial thermal distribution within the Bellows Falls Hydroelectric Project Impoundment and Tailrace**,** and the Connecticut River downstream of the Bellows Falls Dam.

The objectives of this study are to:

1. Obtain continuous temperature data (every 15 minutes) at various locations and depths throughout the project impoundment, tailrace, and downstream Connecticut River using temperature loggers.

2. Analyze data for hourly/daily shifts in temperature regime and thermal distribution (aquatic isotherm maps) associated project specific and cumulative impacts associated with project operations.

3. Determine if any shifts in hourly temperature regime or thermal distribution are impacting aquatic habitat within the project impoundment and tailrace and lower Connecticut River (e.g., thermal blocks to migration, thermal stress, habitat degradation).

Resource Management Goals

Temperature is an important habitat consideration for many aquatic species including migratory fish and rare, threatened, endangered species. Temperature influences the distribution, behavior, metabolism, growth, reproduction, and survival of fishes (Diana 2004). The Connecticut River is considered a Class B waters cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Additionally the Vermont Water Quality Standards states that in Class B cold water fish habitat, the total increase in from any activity or discharge should not result in a temperature increase that exceeds 1.0°F.

Public Interest Consideration

The requestor is a state natural resource agency.

Existing Information

The PAD provides limited information on impacts of project operations ("daily run-of-river") on temperature in the project impoundment, tailrace or lower Connecticut River. Hourly/daily temperature shifts associated with project operations at Bellows Falls Dam can impact aquatic habitat rendering it unsuitable for some organisms. The information in the PAD does not define the spatial extent of temperatures (aquatic isotherm map) within the impoundment, lower Connecticut River. The PAD mainly indicates that in general, temperature did increase from

upstream to downstream while dissolved oxygen decreased, reflecting the impacts of the impoundment.

Project Nexus

The project impounds 26 miles of river that would otherwise be free flowing. It currently operates in a peaking mode, with allowable impoundment fluctuations of up to 3 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1083 cfs). Water quality can be affected by the operating mode of a hydropower project. The PAD provides limited information on how project operations affect water quality within the project impoundment, bypass reach and tailrace. Water temperature can be affected by the operating mode of a hydropower project. The impounded water increases the water surface area of the river reach containing the project. The increased surface acts as a larger solar radiation collector and the thermal mass of the impounded water acts a heat sink storing heat from solar radiation. At night the increased surface area may act as convective radiator that releases heat. Together these attributes may contribute to unnatural thermal properties in the project impoundment that may impact natural temperature regime and influence habitat conditions for fish, wildlife and plant resources (temperature tolerance, life cycle timing (e.g., reproduction or migration), and food availability).

The project discharges regulated Connecticut River flows (“daily run-of-river”) from the impoundment to the downstream seventeen mile reach of the Connecticut River. The project can sporadically release large volumes of impoundment water that may be of a different temperature than the receiving water downstream of the dam. Unnatural and rapid shifts in temperature regimes in the downstream water can impact fish, wildlife and plant resources and instream habitat. The Agency requests that more recent temperature data is collected in a more intensive, systematic and scientific manner in order to assess project specific and cumulative impacts on fish, wildlife and plant resources at the project. Results from this study may be used to directly inform the evaluation of project effects on related resources, such as a fish and other aquatic species.

Proposed Methodology

Use of temperature loggers to gain information on thermal trends has been a standard technique to look at impacts of water storage associated with hydroelectric projects. We recommend that transects be established in the upper, middle, and lower project impoundment, as well as in the tailrace and downstream project. An additional transect should be established in the free flowing section of river above the impoundment to serve as a “reference site”. Inexpensive temperature loggers should be deployed along each transects at a minimum of three locations: at depths of 1 meter subsurface, mid-depth, and 1 meter off the bottom (on buoy lines) where water depths permit. The temperature loggers should be deployed from April 1 – November 15 and be set to record temperature at 15 minute intervals. The temperature loggers should be checked and the data downloaded on the monthly basis. The data from the loggers should then be used to develop hourly/daily aquatic isotherm maps, and temperature change and distribution as a result of project and cumulative impacts should be assessed.

Level of Effort and Cost

The effort and cost of this study is expected to be moderate to high, but the potential project specific and cumulative thermal alteration impacts have never been studied in a comprehensive manner and their potential impacts to aquatic habitat and fish, wildlife, and resources has not been adequately studied.

Literature Cited

Diana, J.S. 2004. Biology and Ecology of Fishes. 2nd edition. Biological Sciences Press.

Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 3: Continuous water temperature monitoring at various locations within the impoundment and tailrace, and downstream Connecticut River

Goals and Objectives

The goal of this study is to determine the potential impacts (both project specific and cumulative) of the Vernon Hydroelectric Project operations on hourly/daily temperature fluctuations and spatial thermal distribution within the Vernon Hydroelectric Project Impoundment and Tailrace**,** and the Connecticut River downstream of the Vernon Dam to the Massachusetts line.

The objectives of this study are to:

1. Obtain continuous temperature data (every 15 minutes) at various locations and depths throughout the project impoundment, tailrace, and downstream Connecticut River using temperature loggers.

2. Analyze data for hourly/daily shifts in temperature regime and thermal distribution (aquatic isotherm maps) associated project specific and cumulative impacts associated with project operations.

3. Determine if any shifts in hourly temperature regime or thermal distribution are impacting aquatic habitat within the project impoundment and tailrace and lower Connecticut River (e.g., thermal blocks to migration, thermal stress, habitat degradation).

Resource Management Goals

Temperature is an important habitat consideration for many aquatic species including migratory fish and rare, threatened, endangered species. Temperature influences the distribution, behavior, metabolism, growth, reproduction, and survival of fishes (Diana 2004). The Connecticut River is considered a Class B waters cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Additionally the Vermont Water Quality Standards states that in Class B cold water fish habitat, the total increase in from any activity or discharge should not result in a temperature increase that exceeds 1.0°F.

Public Interest Consideration

The requestor is a state natural resource agency.

Existing Information

The PAD provides limited information on impacts of project operations ("daily run-of-river") on temperature in the project impoundment, tailrace or lower Connecticut River. Hourly/daily temperature shifts associated with project operations at Vernon Dam can impact aquatic habitat rendering it unsuitable for some organisms. The information in the PAD does not define the spatial extent of temperatures (aquatic isotherm map) within the impoundment, lower Connecticut River. The PAD mainly indicates that in general, temperature did increase from

upstream to downstream while dissolved oxygen decreased, reflecting the impacts of the impoundment.

Project Nexus

The project impounds 26 miles of river that would otherwise be natural free-flowing. It currently operates in a peaking mode, with allowable impoundment fluctuations of up to 8 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1250 cfs). Water temperature can be affected by the operating mode of a hydropower project. The impounded water increases the water surface area of the river reach containing the project. The increased surface acts as a larger solar radiation collector and the thermal mass of the impounded water acts a heat sink storing heat from solar radiation. At night the increased surface area may act as convective radiator that releases heat. Together these attributes may contribute to unnatural thermal properties in the project impoundment that may impact natural temperature regime and influence habitat conditions for fish, wildlife and plant resources (temperature tolerance, life cycle timing (e.g., reproduction or migration), and food availability).

The project discharges regulated Connecticut River flows ("daily run-of-river") from the impoundment to the downstream seventeen mile reach of the Connecticut River. The project can sporadically release large volumes of impoundment water that may be of a different temperature than the receiving water downstream of the dam. Unnatural and rapid shifts in temperature regimes in the downstream water can impact fish, wildlife and plant resources and instream habitat. The Agency requests that more recent temperature data is collected in a more intensive, systematic and scientific manner is needed to assess project specific and cumulative impacts on fish, wildlife and plant resources at the project. Results from this study may be used to directly inform the evaluation of project effects on related resources, such as a fish and other aquatic species.

Proposed Methodology

Use of temperature loggers to gain information on thermal trends has been a standard technique to look at impacts of water storage associated with hydroelectric projects. We recommend that transects be established in the upper, middle, and lower project impoundment, as well as in the tailrace and downstream project. An additional transect should be established in the free flowing section of river above the impoundment to serve as a "reference site". Inexpensive temperature loggers should be deployed along each transects at a minimum of three locations: at depths of 1 meter subsurface, mid-depth, and 1 meter off the bottom (on buoy lines) where water depths permit. The temperature loggers should be deployed from April 1 – November 15 and be set to record temperature at 15 minute intervals. The temperature loggers should be checked and the data downloaded on the monthly basis. The data from the loggers should then be used to develop hourly/daily aquatic isotherm maps, and temperature change and distribution as a result of project and cumulative impacts should be assessed.

Level of Effort and Cost

The effort and cost of this study is expected to be moderate to high, but the potential project specific and cumulative thermal alteration impacts have never been studied in a comprehensive manner and their potential impacts to aquatic habitat and fish, wildlife, and resources has not been adequately studied.

Literature Cited

Diana, J.S. 2004. Biology and Ecology of Fishes. 2nd edition. Biological Sciences Press.

Wilder Hydroelectric Project – FERC No. 1892-026
Bellows Falls Hydroelectric Project – FERC No. 1855-045
Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 4: Model river flows and water levels upstream and downstream from the Wilder, Bellows Falls and Vernon stations and integration of project modeling with downstream project operations

Goals and Objectives

The goal of this study is to develop river flow models that permit the evaluation of the hydrologic changes to the river caused by the physical presence and operation of the Wilder, Bellows Falls, and Vernon Hydroelectric Projects and the interrelationships between the operation of all five hydroelectric projects up for relicensing and river inflows. Specific objectives of this study include:

1. Conduct quantitative hydrologic modeling of the hydrologic influences and interactions that exist between the water surface elevations of the Wilder, Bellows Falls, and Vernon project impoundments and discharges from the Wilder, Bellows Falls, and Vernon projects and the downstream hydroelectric projects including:
    a. Inflows into the Wilder, Bellows Falls, and Vernon impoundments from the Fifteen Mile Falls Project, FERC No. 2007, and other sources;
    b. Existing and potential discharges from the Wilder, Bellows Falls, and Vernon project generating facilities and spill flows, including existing and potential minimum flow and other operational requirements;
    c. Existing and potential water level fluctuation restrictions (maximum and minimum pond levels) of the Wilder, Bellows Falls, and Vernon impoundments, and consequent changes in downstream project discharges; and
    d. Incorporation of the potential effects of climate-altered flows on project operations over the course of the license.
2. Assess how existing and potential operations of the Wilder, Bellows Falls, and Vernon projects affect the operations of the Northfield Mountain and Turners Falls Projects, including:
    a. How Wilder, Bellows Falls, and Vernon flow fluctuations affect pool levels of the Turners Falls impoundment; and
    b. How operations of the Wilder, Bellows Falls, and Vernon projects affect Turners Falls discharges.

Resource Management Goals

The Agency's goals related to aquatic natural resources are to:

1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.

3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The Connecticut River is considered Class B water by the states of Vermont. Vermont lists the section of the Connecticut River below the Wilder dam to Massachusetts line on the Section 303(d) impaired water list due to flow alterations impairing aquatic life and habitat. In Class B waters, Vermont’s water quality standards state that water level fluctuation and flow alterations can only occur to the extent that it supports all uses and does not lead to degradation of the water resource or habitat.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures under the Vermont Water Quality Standards.

Public Interest Consideration
The requestor is a state natural resource agency.

Existing Information
Available information in the PAD does not indicate how project operations have altered the hydrology downstream from each of these facilities, which may affect resident and migratory fish, macroinvertebrates, rare, threatened and endangered species, aquatic plants and other biota and natural processes in the Connecticut River. It is also unclear how operations at one facility affect the operations at another.

Project Nexus
The Wilder, Bellows Falls, and Vernon projects are each currently operated with required minimum flows of 675, 1,083, and 1,250 cfs (or inflows if less) for each facility, respectively, though in practice minimum flows are operated as 700, 1300, and 1600 cfs, respectively. There is presently no required minimum flow for the bypassed reach of the Bellows Falls Project. Each of the projects operates as a daily peaking facility, such that “Generation can vary during the course of any day between the required minimum flow and full capacity if higher flows are available” (p. 2-28, p. 2-29, and p. 2-30 in the Wilder, Bellows Falls and Vernon PADs, respectively). Total hydraulic capacity of each facility is 12,700, 11,010, and 12,634 cfs, respectively. Regular daily fluctuations on the order of 9,000 cfs or greater are commonly recorded at USGS gages 01144500 (Connecticut River at West Lebanon, below Wilder Dam) and 01154500 (Connecticut River at North Walpole, NH, below Bellows Falls Dam). Daily fluctuations in headpond elevation are approximately 2.5’ (382’ to 384.5’ MSL), 1.2’ (289.9’ to 291.1’ MSL), and 1.2’ (218.6’ to 219.8’ MSL) at the Wilder, Bellows Falls, and Vernon impoundments, respectively.

These described changes affect biotic habitat and biota upstream and downstream of each project. Project operations and potential changes to operations to mitigate impacts at each facility are influenced by inflows and operations of upstream projects. Results of river flow analyses will provide necessary information regarding changes that can be made to the Wilder, Bellows Falls, and Vernon Project flow releases and/or water level restrictions, how such changes may be constrained by inflows and upstream project operations, and how these changes potentially affect downstream resources. This information will then be used to develop flow-related license requirements and/or other mitigation measures.

Proposed Methodology

River hydrology statistics and hourly flow modeling are commonly employed at hydroelectric projects to assess implications of project operations on the river environment.

Level of Effort and Cost

Level of effort and cost of model development are expected to be moderate as much of the baseline modeling has already been completed, but running of various scenarios through the model(s) will be needed throughout the relicensing process to assess the implications of changes to the operations of each project on other projects and other resources. The modeling exercise will also require coordination and cooperation between TransCanada and the downstream licensee to assure that the model inputs and outputs can be accurately related.

We would anticipate that the expected level of effort and anticipated costs will be comparable to that experienced on similar FERC relicensing projects of this size (e.g., Conowingo, FERC No. 405).

Wilder Hydroelectric Project – FERC No. 1892-026
Bellows Falls Hydroelectric Project – FERC No. 1855-045
Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 5: Climate change as it relates to continued operation of the Vernon, Bellows Falls and Wilder projects

Goals and Objectives

The goal of this study is to determine how climate change relates to the continued operation of the Vernon, Bellows Falls, and Wilder projects.

The objectives of this study are:

1. Quantify the amount of thermal loading contributed by each respective impoundment
2. Using climate change prediction models, calculate how much warmer the project impoundments are projected to get in the next 30-50 years.
3. Model the effect of various project modifications on river temperature under current conditions and climate change predictions (e.g., converting to run-of-river, deep-water releases, dam removal, large-scale riparian revegetation, etc.).
4. Using climate change prediction models, determine if the projects actually provide an environmental benefit with respect to mitigating against climate change impacts (warming of air and water temperatures) by producing low greenhouse gas emitting energy.
5. Determine how climate change predictions will impact management of high flow events at the three projects and evaluate if changes to dam structures would mitigate adverse impacts of the existing flood management protocols.

Resource Management Goals

The Agency's goals related to aquatic natural resources are to:

1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The Connecticut River is classified by the State of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the Vermont Fish and Wildlife Department's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.

2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Specific to climate change, Executive Order 11-05 by the Governor established the Climate Cabinet to provide coordinated leadership in the states effort to adapt to climate change.
The Agency goals as it relates to climate change initiatives are:

1. Improve our understanding on the effects of climate change in Vermont on natural resources and ecosystem services.
2. Identify adaptation strategies that could be used to protect Vermonter's, their property, and the state's natural resources and ecosystem services they provide.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Agency goals.

Public Interest Consideration

The requester is a resource agency.

Existing Information

The PADs contains no information relative to climate change and how climate change predictions may impact future operation of the hydroelectric plants, nor of how the projects either mitigate for or exacerbate predicted climate change impacts to freshwater ecosystems.

TransCanada's PADs provide a summary of water quality data collected in 2012. Table 1 below is a synthesis of the temperature data collected by TransCanada. It should be noted that the upper and mid-impoundment stations at each project represent the average of temperature readings taken over the entire water column, while the continuous loggers (Lower Cont. and TR) were located near the water surface. These data indicate that from the upstream end of the Wilder headpond to the Vernon tailrace, water temperature increased approximately 6°C.

Table 1. Median water temperature at monitoring stations located within the impoundments and tailraces of the three hydropower projects.

	Median Water Temperature °C			
Project	Upper Imp.	Mid-Imp.	Lower Cont.	TR
Wilder	20.86	21.83	24.08	23.59
BF	22.43	23.67	24.86	24.38
Vernon	23.81	24.49	26.73	26.35

Relative to existing flood management protocols at each station, TransCanada's PADs identify that all three dams utilize stanchion bays (two at Vernon, three at Bellows Falls, and four at Wilder). When inflows to each dam reach certain levels, the stanchion bays are removed, and cannot be replaced until inflows subside. The depth of these bays and the flows they are removed at are outlined in Table 2, below.

Table 2. Summary of pertinent stanchion bay Information for the Vernon, Bellows Falls, and Wilder projects.

Project	Stanchion Height (feet)	Flow Triggering Complete Stanchion Removal
Wilder	17	145,000 cfs
BF	13	50,000 cfs
Vernon	10	105,000 cfs

The PADs provide no information on the history of stanchion removal at any of the projects (frequency, duration, timing), nor a discussion of how predicted climate change might alter management of the stanchion bays in the future (with respect to the frequency and seasonality of occurrence). There also is no discussion of potential impacts to headpond resources that occurs as a result of stanchion bay removal. These information gaps need to be filled so resource agencies can assess the relative and cumulative impact of project operations with respect to the Agency's management goals and objectives.

Data provided by the National Oceanic and Atmospheric Administration, Climate Data Center, illustrates long-term increasing air temperatures in the Northeast (Figure 1). Long-term, monthly mean water temperature data for the Vernon Dam impoundment, monitored by Vermont Yankee, has shown significant differences over time (ANOVA analyses, $P < 0.05$) that when plotted and further analyzed by linear regression, show a significant increasing trend for the period 1974 – 2011 for the months of January, September, and October (Figure 2). These analyses were performed with data from Vermont Yankee, analyzed by the Massachusetts Department of Environmental Protection.

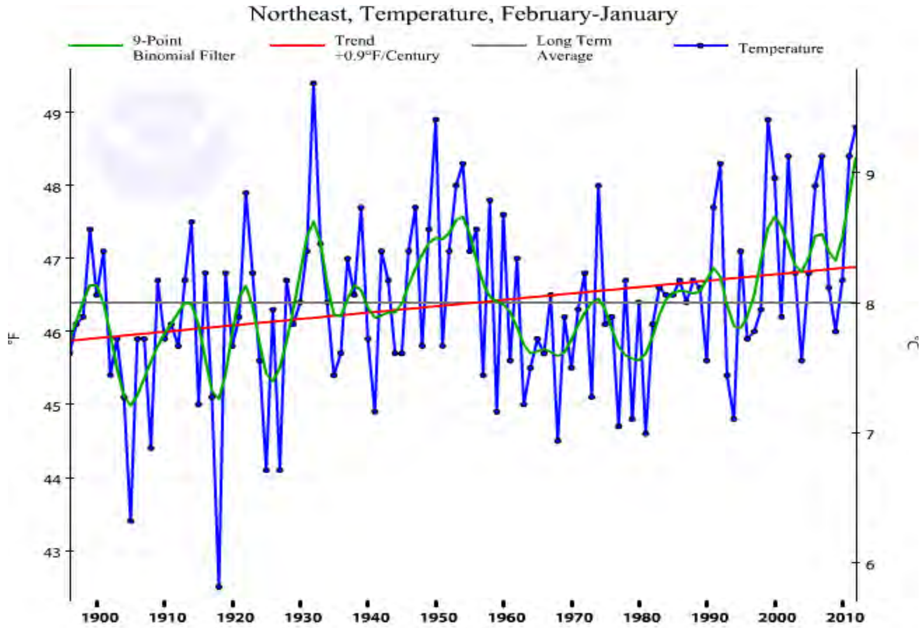


Figure 1. NOAA National Climate Data Center, Northeast 12-month average temperature for the period 1896 through 2012 (October).

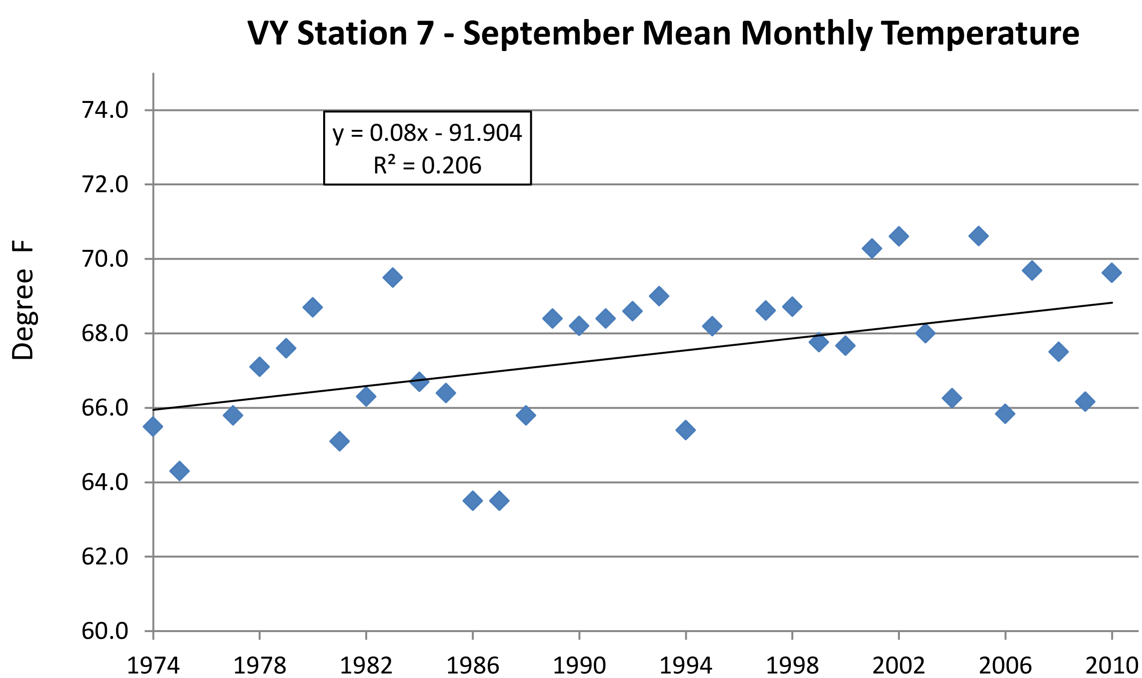


Figure 2. A plot of September's mean temperatures for Vermont Yankees' Station 7 (excludes outlier 1996 data point) for the period 1974 through 2011.

Project Nexus

The three mainstem projects have very long impoundments capable of storing large volumes of water (Table 3, below). These impoundments effectively have converted large portions of the Connecticut River into a series of in-river "lakes." Because water velocities slow in these impounded sections of river, it allows for increased thermal loading and resultant higher water surface temperatures than in free-flowing sections of river.

Table 3. Relevant characteristics of the reservoirs behind the Wilder, Bellows Falls, and Vernon.

Project	Headpond Length (miles)	Gross Storage Volume (acre-ft.)	Average Depth (ft.)	Surface Area (acres)	Flushing Rate (days)
Wilder	45	34,350	11	3,100	3
BF	26	26,900	10	2,804	<2
Vernon	26	40,000	16	2,550	2

Depending on where the hydropower intakes withdraw water, these warmer surface waters may be discharged downstream, raising the temperature of those waters as well (the data in Table 1 above suggest that the projects do draw water from the upper levels of the reservoirs). This effect may be felt for miles downstream. If there are a series of impoundments (like on the Connecticut River), the cumulative impact is an overall warming of the river. Even small run-of-river dams have been shown to elevate downstream water temperature (Lessard and Hayes 2003; Saila et al. 2005). The most recent climate change prediction models specific to the northeast forecast warmer air temperatures, more frequent high precipitation events, more heat waves, and an increase in the incidence of short term droughts (Karl et al. 2009).

Resource concerns related to this project effect include the potential impacts to populations (reductions in abundance, structure, condition) or loss of species not tolerant of increases in temperature and other effects related to physiology such as energetic costs with warmer temperatures (Leggett 2004). As one example, American shad restoration target numbers for fish passage at mainstem dams into upstream historic habitat could be negatively impacted from artificially increased water temperatures. Water temperature has been identified as a factor in the timing (i.e., duration) of this species migration, as well as its role in gonad development and spawning (Glebe and Leggett 1981; Leggett 2004). These factors can be logical reasoned to potentially result in accelerated rates of energy reserve use and a reduced migration window, possibly reducing the ability of fish to reach up-river habitats and further reducing the ability to survive downstream outmigration.

With respect to project operations during high flow events, all TransCanada projects have stanchion bays that are used to manage water during high flow events. Each time these stanchion bays are removed, the headponds are lowered substantially (from 10 to 17 feet, depending on the project) and must remain lowered until inflows subside. Depending on the timing and duration of these deep drawdowns, headpond resources could be negatively impacted.

All of the dams also contain other mechanisms for managing flows, such as Tainter gates, sluice gates, roller gates, skimmer gates and hydraulic flood gates. All of these gates have an advantage over stanchion bays in that they do not require flows to subside significantly before they can be closed to return impoundment levels back to normal. One climate change prediction for the northeast is that we will see more frequent high precipitation events which will result in high flow conditions on rivers. Therefore, it is likely that the stanchion bay removal protocol will have to be employed more frequently in the future.

Proposed Methodology

1. In order to quantify the amount of thermal loading contributed by each respective impoundment, detailed bathymetry will need to be collected. This bathymetry, combined with storage volume, tributary hydrology, and project operations, should be used to calculate the thermal loading of each headpond. The individual and cumulative increase in surface water temperature due to the impoundments should then be used to predict future warming based on climate change models.

2. Analyze different mitigation strategies to understand which have the greatest benefit in terms of building resilience against the impacts of climate change on water temperature. Potential scenarios to analyze include converting the projects to run-of-river, implementing deep-water releases, removing one or more dams, conducting large-scale riparian revegetation, etc.).

3. Input to climate change models the amount of GHG emissions that would be generated if fossil fuel plants were producing the equivalent amount of net energy as the three hydropower projects to determine the impact on air and surface water temperatures.

4. Climate change prediction model output should be assessed to determine if the frequency and timing of high flow events is likely to change in the future. If high flow events that necessitate initiating the stanchion bay removal protocol are predicted to increase in frequency and/or shift in timing, the applicant should evaluate structural and/or operational alternatives that would mitigate adverse impacts of the existing flood management protocols.

Level of Effort and Cost

The level of cost and effort for the thermal loading analysis would be low to moderate. Collecting bathymetry in the three TransCanada headponds would take two staff less than one week to collect (it took the Kansas Biological Survey two days to collect bathymetry at a 3,500 acre lake; Jakubauskas et al. 2011). The remaining work would be desk-based; loading relevant information into an appropriate thermal loading model to compute the estimated thermal loading of each headpond and then comparing this information to surface water data from climate change prediction models.

The high flow flood protocol study is a desktop analysis that should require low cost and effort. Climate change models already exist and that output would be downloaded and analyzed. The remaining analysis requires a review of alternative means of managing flows without the use of stanchion bays.

The applicant did not propose any studies to meet this need in the PAD.

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Bellows Falls Hydroelectric Project – FERC No. 1855-045

Study Request 6: Bypass flow and habitat

Goals and Objectives

The goal of this study is to determine appropriate bypass flows meet Vermont surface water quality standards and that will protect and enhance the aquatic resources of the Bellows Falls bypass reach.

The objective of the study will be to evaluate the relationship between flow and habitat suitability in the bypass reach and evaluate the impacts of the "barrier dam" in the downstream portion of the bypass reach.

Resource Management Goals

The Connecticut River is considered Class B water by the states of Vermont. Vermont lists the section of the Connecticut River below the Wilder dam on the Section 303(d) impaired water list due to flow alterations impairing aquatic life and habitat. In Class B waters, Vermont's water quality standards state that water level fluctuation and flow alterations can only occur to the extent that it supports all uses and does not lead to degradation of the water resource or habitat.

The Agency's goals related to aquatic natural resources are to:

4. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
5. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
6. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

Specific to aquatic resources within the Bellows Falls bypass reach, the Agency's goals are:

1. Protect, enhance, or restore, diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
2. Provide appropriate flows in the bypass reach that meets the life history requirements of resident fish and wildlife, including freshwater mussels and other benthic invertebrates.
3. Minimize current and potential negative project operation effects on water quality and aquatic habitat.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures under the Vermont Water Quality Standards.

Public Interest Consideration

The requester is a resource agency.

Existing Information

The Bellows Falls Project bypasses a 3,500 foot-long section of the Connecticut River. There is a small concreter barrier dam in the lower portion of the bypass reach which was installed to "prevent upstream migrating fish from being attracted by spillway discharge into the reach and later becoming trapped in isolated pools after the spill ends." Presently this bypass reach only receives flow when inflow exceeds the hydraulic capacity of the Bellow Falls station. According to exceedance curves provided in the PAD, on a monthly basis the bypass reach receives flow the following amount of time:

Month	**% time flow > 11,000 cfs**	**Month**	**% Time Flow >11,000 cfs**
Jan.	15	July	10
Feb.	15	August	8
March	50	Sept.	4
April	90	Oct.	20
May	60	Nov.	35
June	20	Dec.	26

No information exists on the adequacy of the existing bypass flow regime to protect water quality and aquatic life. The bypass reach receives flow less than 30% of the time on an annual basis. While TransCanada did conduct a preliminary water quality study in the summer of 2012 that indicated water quality at the bypass reach sample station was not meeting state water quality standards, only a summary of the data are provided in the PAD. It does not indicate where the sonde was located, nor the bypass reach conditions during the study period (e.g., what was the flow into the bypass reach during the study? Was the sonde located in the only wetted area of the bypass reach?). Further, the PAD provides no detailed description of the physical or biological characteristics of the bypass reach.

An empirical study is needed to provide information on the relationship between flow and habitat in the bypass reach for the Agency to use in determining appropriate flows in the bypass reach.

Project Nexus

The Project includes a 3,500-foot-long bypass reach. Absent a mandated discharge at the dam, this habitat would remain dewatered during those times when inflow was within the hydraulic capacity of the units (~70% of the time on an annual basis). The existing license does not require any flow through the bypass reach. The current situation does not sufficiently protect the aquatic resources inhabiting or potentially inhabiting the bypass reach.

The Connecticut River in the project vicinity is dominated by sections that are impounded, backwatered from downstream impoundments or otherwise deep and slow-flowing. In contrast, the Bellows Falls bypass channel is very irregular and diverse, consisting of both coarse substrate of various sizes and in the more downstream segment, jagged, irregular ledge. Given an adequate flow regime, the bypass could provide habitat types that are now rare and therefore of great importance.

Results of the flow study will be used by the Agency to determine an appropriate flow recommendation that will protect and/or enhance the aquatic resources in the bypass reach for the duration of any new license issued by the Commission.

Proposed methodology

The Agency requests a bypass flow study be conducted at the Project. Bypass flow habitat assessments are commonly employed in developing flow release protocols that will reduce impacts or enhance habitat conditions in reaches of river bypassed by hydroelectric projects.

Given the size of the bypass reach (3,500 feet long) and the rareness of the habitat types it contains in this portion of the Connecticut River, we believe a study methodology that utilizes an IFIM approach is appropriate for this site. This same protocol was used during the relicensing of the Housatonic River Project (FERC No. 2576),[1]and has been accepted by the Commission in other licensing proceedings[2].

Given the unique channel formation habitat modeling using standard PHABSIM 1-dimensional modeling may not be sufficient to assess the habitat suitability in the bypass reach but rather 2-dimensional, (2D) modeling may be needed to better characterize flows and velocities in this reach. We recommend that the approach to habitat modeling be determined during the study plan development stage based on consultations between the applicant and the resource agencies.

Level of effort and cost

The expected level of effort and anticipated costs will be comparable to that experienced on similar FERC relicensing projects of this size.

Field work for flow studies can be reasonably extensive but will depend on consultation with the applicant on study methodology and on-site decisions on locations for data collection and the number of collection locations. Post-fieldwork data analysis would be a moderate cost and effort. Field work associated with this study could be done in conjunction with the Instream Flow Study Request. We anticipate that the level of effort and costs will be comparable to that experienced on similar FERC relicensing projects (e.g., the Glendale Project, FERC No. 2801).

[1] Housatonic River Project License Application, Volume 4, Appendix F. Connecticut Light and Power Company, August 1999.

[2] Glendale Project (FERC No. 2801) Final Bypass Reach Aquatic Habitat and Instream Flow Study in Glendale Hydroelectric Project Application for Subsequent License (FERC No. 2801), Volume 2, Appendix B, pages 7-8, October 2007.

Wilder Hydroelectric Project – FERC No. 1892-026
Bellows Falls Hydroelectric Project – FERC No. 1855-045
Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 7: In-stream flow habitat assessment of downstream reaches

Goals and Objectives

The goal of this study is to determine an appropriate flow regime that will protect and enhance the aquatic resources below the Wilder, Bellows Falls, and Vernon projects. Specifically, the objective of this study is to conduct an instream flow habitat study to assess the impacts of the range of proposed project discharges on the wetted area and optimal habitat for key species.

The study should include non-steady flow approaches to assess effects of within-day flow fluctuations due to peaking power operations on target fish species and benthic invertebrate communities. Target species will include but are not limited to: American shad, fallfish, white sucker, yellow perch, smallmouth bass, walleye, and dwarf wedge mussel.

Resource Management Goals

The Connecticut River is considered Class B water by the states of Vermont. Vermont lists the section of the Connecticut River below the Wilder dam on the Section 303(d) impaired water list due to flow alterations impairing aquatic life and habitat. In Class B waters, Vermont's water quality standards state that water level fluctuation and flow alterations can only occur to the extent that it supports all uses and does not lead to degradation of the water resource or habitat.

The Agency's goals related to aquatic natural resources are to:

7. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
8. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
9. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures under the Vermont Water Quality Standards.

Public Interest Consideration

The requestor is a state natural resource agency.

Existing Information

The distance from the upstream end of the Wilder impoundment downstream to the Vernon dam is 120 miles. A total of 97 miles (81%) of this segment is impounded. The remaining riverine habitat is within the 17 miles downstream of Wilder dam and the 6 miles downstream of Bellows Falls. At the scoping meetings, First Light also indicated that their project assessment may provide evidence that the upstream extent of the Turners Falls impoundment may not reach all the way to Vernon Dam. This would suggest that there may be additional riverine habitat for a presently unknown distance below the Vernon project.

The Wilder, Bellows Falls, and Vernon projects are each operated as daily peaking facilities. Total hydraulic capacity of each facility is 12,700, 11,010, and 12,634 cfs, respectively. Each of the PADs for these projects indicate that "Generation can vary during the course of any day between the required minimum flow and full capacity if higher flows are available" (p. 2-28, p. 2-29, and p. 2-30 in the Wilder, Bellows Falls and Vernon PADs, respectively). Regular daily fluctuations on the order of 9,000 cfs or greater are commonly recorded at USGS gages 01144500 (Connecticut River at West Lebanon, below Wilder Dam) and 01154500 (Connecticut River at North Walpole, NH, below Bellows Falls Dam). Required minimum flows are 675, 1,083, and 1,250 cfs (or inflows if less) for each facility, respectively, though in practice minimum flows are operated as 700, 1300, and 1600 cfs, respectively. The PADs for these projects do not indicate how these minimum flow requirements were established or what specific ecological resources they are intended to benefit. The Agency is not aware of any previously conducted studies that have evaluated the adequacy of this minimum flow in protecting aquatic resources in the 23+ miles of riverine habitat below these projects, nor project effects of daily hydropeaking on riverine habitat. Therefore, in order to fill this important information gap, an empirical study is needed to provide information on the relationship between flow and habitat in the Connecticut River downstream of the Wilder, Bellows Falls, and Vernon projects. Results will be used by the Agency to determine an appropriate flow recommendation.

Project Nexus

The Wilder, Bellows Falls, and Vernon projects are currently operated with a minimum flow release that was not based on biological criteria or field study. Further, the projects generate power in a peaking mode resulting in substantial within-day flow fluctuations between the minimum and project capacity. The large and rapid changes in flow releases from peaking hydropower dams are known to cause adverse effects on downstream habitat and biota (Cushman 1985, Blinn et al. 1995, Freeman et al. 2001). There are at least 23 miles of lotic (flowing) habitat below the project's discharge that are impacted by peaking operations from these projects. This section of the Connecticut River contains habitat that supports native riverine species, including the federally endangered dwarf wedge mussel, and could include spawning and rearing habitat for migratory fish such as American shad. While the existing licenses of the Wilder, Bellows Falls, and Vernon projects do require a continuous minimum flow of 675, 1,083, and 1,250 cfs, respectively, we do not believe this flow sufficiently protects the aquatic resources, including endangered species, of these river reaches, especially in the context of the magnitude, frequency, and duration of changes in habitat that likely occur due to hydropeaking operations.

Results of the flow study will be used by the Agency to determine an appropriate flow recommendation that will protect and/or enhance the aquatic resources below the Project.

Proposed Methodology

In-stream flow habitat assessments are commonly employed in developing operational flow regimes that will reduce the impacts or enhance habitat conditions downstream of hydroelectric projects.

The Service requests a flow study be conducted in the following areas: in the approximately 17 miles between the Wilder Dam and the headwaters of the Bellows Falls pool, in the approximately 6 miles between the Bellows Falls Dam and the headwaters of the Vernon pool, and in the approximately 1.5 miles between Vernon Dam and the downstream end of Stebbins Island (or the upstream extent of the Turners Pool as determined by First Light, whichever river length is greater).

Given the length of river reach (23+ miles) impacted by project operations, we believe a study methodology that utilizes an IFIM approach is appropriate for this context. Similar protocols have been used and accepted by FERC in numerous other licensing proceedings.

The study design should involve collecting wetted perimeter, depth, velocity, and substrate data along transects in the deep, straight-channel areas of the specified river reaches mentioned above. Two-dimensional hydraulic modeling should be conducted in the sections of river with more complex features such as islands, braiding, falls, and shallow-water shoals. The measurements should be taken over a range of flows sufficient to model the full extent of the operational flow regime. This information should then be synthesized to quantify habitat suitability (using mutually agreed-upon habitat suitability index (HSI) curves) over a range of flows for target species identified by the fisheries agencies. Data should be collected in such a way that allows a dual-flow analysis and habitat time series or similar approaches that will permit assessment of how quality and location of habitat for target species changes over the range of flows that occur as part of the operational flow regime.

Level of Effort and Cost

Field work for instream flow studies can be reasonably extensive but will depend on consultation with the applicant on study methodology and on-site decisions on locations for data collection and the number of collection locations. Use of laser measurements, GPS, and/or an Acoustic Doppler Current Profiler (ADCP, if available) can improve efficiency and accuracy of field measurements. Post-fieldwork data analysis would be a moderate cost and effort. We anticipate that the level of effort and costs will be comparable to that of other FERC relicensing projects of similar size to these projects.

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Wilder Hydroelectric Project – FERC No. 1892-026
Bellows Falls Hydroelectric Project – FERC No. 1855-045
Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 8: Project effects on channel morphology and benthic habitat impacts

Goals and Objectives
It is well known that dams interrupt the downstream continuum of sediment supply and transport, which in turn can affect channel morphology and limit the amount of coarse (i.e. gravel/cobble) substrate available for aquatic biota. The Vernon, Bellows Falls and Wilder projects' effects on fluvial processes, channel formation and associated anadromous and riverine fish habitat, as well as aquatic invertebrate habitat, is unclear. This study request aims to provide information on coarse sediment supply and transport as it relates to aquatic benthic habitat (e.g. gravel bars). Results will be used to identify techniques to minimize and/or mitigate impacts to this valuable habitat.

The goal of this study is to understand how the projects affect bedload distribution, particle size and composition as it relates to habitat availability (amount and size of coarse substrate material) for different life-history stages of anadromous (e.g. sea lamprey) and riverine fishes (e.g. walleye), as well as invertebrates (e.g. mussels, tiger beetles).

The study objectives include:

1. Assess the distribution and extent of the existing substrate types, including gravel and cobble bars within the project affected areas.

2. Identify the current conditions of the channel and determine the stability of the present substrate/benthic habitat and identify if flow or sediment measures are necessary to improve the aquatic benthic habitat.

Resource Management Goals
The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).
Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.

2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Gravel/cobble habitat is utilized by various riverine fish species during different life history stages and seasons, as it provides sites for spawning, feeding, and refuge (Gore and Shields 1995). Many fish species and aquatic invertebrates (e.g., fresh water mussels, snails, worms, and aquatic insects) live on or near gravel habitat, because it provides a source of food and cover (Miller 1988). Gravel bars also play an important role in water quality, hydrology, and morphology of rivers (Lewis 2005).

As identified in Vermont's Wildlife Action plan (Kart et al. 2005), several state listed mussel species are known to utilize gravel-type substrate. Furthermore, sea lamprey (*Petromyzon marinus*) spawning occurs over substrate composed of a mixture of sand, gravel and rubble. The sea lamprey, within the Connecticut River drainage, is one of New Hampshire and Vermont's Species of Greatest Conservation Need (SGCN). The conservation status of sea lamprey in New Hampshire is listed as "vulnerable." One of the threats identified in Vermont's Wildlife Action Plan (Kart et al. 2005) is degraded spawning habitat, which is second to habitat fragmentation. In support of VTFWD's mission, and the Vermont Water Quality Standards, gaining a better understanding of the benthic habitat present in project affected areas how projects operations may be affecting this habitat is important.

Public Interest Consideration

The requestor is a state natural resource agency.

Existing Information

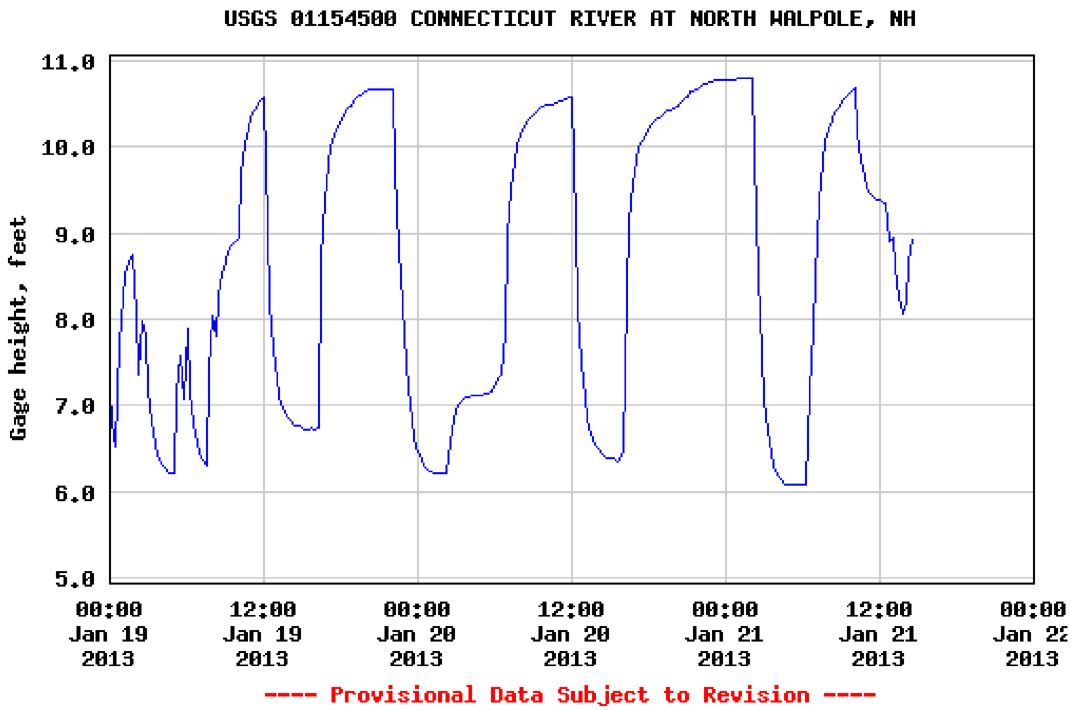
The PAD generally focusses on erosional impacts due to the projects' operations, but lacks specific information on fluvial geomorphic processes and substrate composition as it relates to impacts to aquatic benthic habitat. Recent studies assessing fluvial geomorphic process and substrate composition in Connecticut River tributaries have documented the impacts of regulated flows from dams on substrate composition, and the possible impacts on the mainstem of the river.

Curtis et al. (2010) utilized a combination of historical aerial photographs, mainstem- and tributary-channel pebble counts, and HEC-RAS flow modeling in the West and White River watersheds (tributaries to the Connecticut River). They documented the time series of post-regulation channel narrowing and associated bar growth due to the influx of tributary sediment. In the West River, Svendsen et al. (2009) quantified changes in channel bed morphology as a result of flow regulation. Utilizing bi-monthly cross-section data from the gauging stations they determined the mean water depth and bed elevation for each cross-section measurement during the pre-dam and post-dam periods. In addition, annual peak stream flow data for each station were used to calculate the flood recurrence, and surface grain distributions at sampling sites upstream and downstream of each tributary confluence using Wolman pebble counts. They found that the sediment load from tributaries are impacting the flow-regulated mainstem West River rather than ameliorating conditions, and that these impacts are reflected in the benthic community structure. These results indicate that environmental flows that mimic the natural hydrograph are needed in regulated reaches of river.

Project Nexus

Dams have major impacts on geomorphic processes, ecological function and in turn biotic communities. Changes to substrate composition can significantly affect aquatic life include stability of channel habitats, size distribution and embeddedness of substrate, and decreased habitat diversity and heterogeneity. The projects impound a large portion of the Lower Connecticut River that otherwise would be free flowing and would transport fine sediment downstream leaving larger substrate material (gravel/cobble) exposed to be utilized by aquatic biota. By interrupting the downstream continuum of sediment supply and transport, dams can result in increased bed scour and bank erosion downstream (Kondolf and Matthews 1993). Given the large number of mainstem dams on the Connecticut River, any gravel coming in from tributaries becomes very important to the system. However, many of the tributaries in the project reach have also been dammed, predominantly for flood control. Therefore, there is reason to be concerned about the effects the project dams are having on river processes and physical habitat. Currently, the projects operate as hydro-peaking facilities as is evident from the USGS stream flow gauge at North Walpole, NH; with large water releases below the dam that increase shear stress on the river bed, substrate is mobilized that otherwise would only be moved during seasonal high flow events. Operations of the existing TransCanada hydroelectric projects likely affect channel morphology and fluvial processes including substrate mobility, and particle size distribution. Project-induced changes to natural fluvial processes and channel morphology and substrate composition can have negative impacts on aquatic resources. For example, changes in sediment composition could relocate or decrease important walleye and sea lamprey spawning habitat. In a similar fashion, project-induced changes could make some habitats unsuitable for aquatic invertebrates, including the federally-endangered dwarf wedgemussel. The Vermont Agency of Natural Resources requests a study investigating the impacts of project operations on fluvial processes, substrate composition and stability as it relates to aquatic benthic habitat. Results of this study will be used to develop potential license requirements to protect aquatic habitat in the project-affected areas, and may be used to inform other studies that evaluate project effects on related resources. Possible mitigation measures could include gravel augmentation, changes in flow regulation, and instream channel restoration.

An example of the water level fluctuations that occur in Lower Connecticut River due to hydropower generation is shown below.



Proposed Methodology

Geomorphology studies are generally conducted during hydroelectric relicensing projects to determine channel condition, and substrate composition, and determine whether changes in project operations or sediment measures are necessary and/or whether channel restoration is necessary to improve aquatic benthic habitat.

The Agency recommends a methodology similar to previously approved FERC studies (FERC No. 2246 and 2206). Specific study methods include but are limited to utilizing a combination of historical aerial photographs, pebble counts, and HEC-RAS flow modeling to document and compare temporal changes in morphology and sediment transport dynamics in the Project effected areas.

Additional study methods can be found in the FERC Project No. 2246, Yuba County Water Agencies Study Plan Determination: Study 1.1. Lemonds (2006) also conducted an empirical-based study for the Yadkin-Pee Dee River Hydroelectric Project No. 2206.

The study plan should be developed in consultation with the Agency.

Level of Effort and Cost

At a minimum the study would require a combination of historical aerial photographs, pebble counts, and HEC-RAS flow modeling. Cross-section data from the gauging stations could be used to determine the mean water depth and bed elevation for each cross-section measurement. TransCanada has not proposed any studies to meet this need.

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Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 9: Juvenile shad outmigration

Goals and Objectives

Determine if project operations affect juvenile American shad outmigration survival, recruitment, and production. The following objectives will address this request:

- Assess project operation effects of Vernon Dam on the timing, routes, migration rates, and survival of juvenile shad;
- Determine the proportion of juvenile shad that as a downstream passage route choose or are directed to existing downstream bypass structures, gate structures, or are entrained into the station turbines and assess delay, survival, timing, and related impacts with these locations under a full range of operational conditions, over the period of outmigration;
- Determine survival rates for juvenile shad entrained into Vernon Station units.

If it is determined that the project operations or related effects are adversely affecting juvenile shad survival, migration timing, or other deleterious population effects are noted, identify operational solutions or other solutions that will reduce and minimize impacts, within the project affected area. This study will require two years of field data to capture inter-annual variability of river discharge, water temperature, and variability in run size and juvenile production (and timing of developmental stages) and variability in outmigration timing which may relate to spring, summer and fall conditions.

Resource Management Goals

The Agency's goals related to aquatic natural resources are to:

1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Vermont Fish and Wildlife Department's Strategic Plan (2002 -2010) focuses towards four major areas of concern: resource conservation, fish and wildlife-based recreation and use, human health and safety, efficient operations, and effective management.

The Connecticut River Atlantic Salmon Commission (CRASC) was established by Congress in 1983 (and reauthorized in 2002 for another 20 years) through the Connecticut River Atlantic Salmon Compact (Public Law 98-138). The Vermont Fish and Wildlife Department is a CRASC member agency, and a senior biologist from the department serves on the Technical Committee. The Connecticut River Atlantic Salmon Commission developed *A Management Plan for American Shad in the Connecticut River* in 1992. Management Objectives in the plan include the following:

1. Achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually.
2. Maximize outmigrant survival for juvenile and spent adult shad.

The Atlantic States Marine Fisheries Commission Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management), approved in 2010 includes the following objective:

- Maximize the number of juvenile recruits emigrating from freshwater stock complexes.

The Agency seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to American shad, the Agency's goals are:

- Minimize current and potential negative project operation effects on juvenile American shad survival, production, and recruitment.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq*.), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq*.), and the Federal Power Act (16 U.S.C. §791a, *et seq*.).

Public Interest Consideration

The requestor is a resource agency.

Existing Information

Adult shad are counted annually as they pass above the Vernon Dam. Juvenile American shad production has been monitored upstream of the Vernon Dam and immediately downstream of that dam by Vermont Yankee Nuclear as part of an annual monitoring program using both boat electrofishing (since 1991) and beach seining (since 2000). A seasonal average annual index of juvenile American shad standing crop in Vernon reservoir has been calculated since 2000. Estimates of juvenile shad growth rates in the Vernon impoundment have been calculated annually beginning in 2004, and also in a study conducted in 1995 (Smith and Downey 1995).

Although there were numerous studies of downstream passage facilities at the Vernon Project for Atlantic salmon smolts, studies passage studies for American shad were limited to tests in 1991 and 1992 of a high frequency sound field to guide fish to the fish pipe, the primary downstream fishways in 1991 and 1992 (RMC 1993). Although the studies were deemed incomplete, the technology indicated some level of response by juvenile shad. However, despite that conclusion, there is no indication that this technology or other downstream passage studies with juvenile shad were subsequently pursued.

Project Nexus

Juvenile American shad production occurs in the river reach between the Vernon Dam and the Bellows Falls Dam, which is thought to be the historic upstream limit of the shad migration in the Connecticut River. Juvenile American shad require safe and timely downstream passage measures to have the opportunity to contribute to the restoration target population size.

There is little information available regarding the total impact of the Vernon project on downstream migration of juvenile shad. Migration delays, increased predation, mortality during passage over the dam or through turbines, and changes in route selection under different flow conditions are potential influences of the Vernon Dam on the juvenile shad population in the upper Connecticut River. Effective upstream and downstream passage and successful in-river spawning and juvenile production are necessary to help achieve shad management restoration goals for the Connecticut River, particularly in the upstream reaches. Delays in juvenile American shad outmigration may affect survival rates in the transition to the marine environment (Zydlewski et al. 2003).

Proposed Methodology

The impact to juvenile shad outmigrants would be best studied by a combination of approaches including hydroacoustics, radio telemetry (including passive integrated transponder (PIT) telemetry), and turbine balloon tags. Project discharge adjustments at the dam should be examined relative to timing, duration, and magnitude of juvenile shad migration to and through the dam, with hydroacoustic equipment for natural/wild fish information. In addition, study fish should be collected and tagged (PIT, radio, balloon) to then empirically determine rates of survival for fish passed through the project under varied operations, from minimum flows up to full spill conditions. The release of tagged fish (radio, PIT) at a number of potential sites will provide data on delay and route selection as juvenile shad move through the Vernon project area. The number and location of release sites will depend on the availability of tagged fish.

Additional hydroacoustic assessment immediately upstream and downstream of the Vernon Dam will provide information on the timing of migration to and through this area. A more focused survival study, using balloon tags, PIT tags, or other appropriate methods, should be conducted in the second year based upon the first year of study findings relative to the frequency, magnitude, timing, and route selection of juvenile American shad through the Vernon project.

Level of Effort and Cost

TransCanada does not propose any studies to meet this need. Estimated cost for the study is expected to be up to $150,000 with the majority of costs associated with equipment (hydroacoustic gear, radio tags, radio receivers, and PIT readers) and related fieldwork labor.

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Turners Falls Hydroelectric Project – FERC No. 1889-081
Northfield Mountain Pumped Storage Project – FERC No. 2485-063

Study Request 9: Juvenile shad outmigration

Goals and Objectives

Determine if project operations affect juvenile American shad outmigration survival, recruitment, and production. The following objectives will address this request:

- Assess project operations effects of NMPS and Turners Falls Dam on the timing, orientation, routes, migration rates, and survival of juvenile shad;
- Determine the proportion of juvenile shad that select the Gatehouse into the power canal versus the dam spill gates as a downstream passage route, under varied operational conditions, including a range of spill conditions up to full spill;
- Determine if there are any delays with downstream movement related to either spill via dam gates or through the Gatehouse and within the impoundment due to operations (i.e., NMPS pumping and generation);
- Determine survival rates for juvenile spilled over/through dam gates, under varied operation conditions, including up to full spill during the annual fall power canal outage period;
- Determine the juvenile downstream passage timing and route selection in the power canal to: Station 1; Cabot Station; and the Cabot Station log sluice bypass, and assess delays associated with each of these locations and with project operations (e.g., stockpiling in the canal);
- Based upon year 1 study results on route selection, determine the survival rate for juvenile shad entrained into Station 1; and
- Determine the survival rates for juvenile shad entrained into Cabot Station units;

If it is determined that the Project operations are adversely affecting juvenile shad survival, migration timing, or other deleterious population effects , identify operational solutions or other passage measures that will reduce and minimize these impacts within the project area. This study will require two years of field data to capture inter-annual variability of river discharge, water temperatures, and variability in the timing and abundance of juvenile production and their outmigration timing, which may relate to spring, summer, and fall conditions. This study will compliment the NMPS Fish Entrainment Study Request which includes assessment of impacts to juvenile shad.

Resource Management Goals

The Agency's goals related to aquatic natural resources are to:

1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Vermont Fish and Wildlife Department's Strategic Plan (2002 -2010) focuses towards four major areas of concern: resource conservation, fish and wildlife-based recreation and use, human health and safety, efficient operations, and effective management.

The Connecticut River Atlantic Salmon Commission (CRASC) was established by Congress in 1983 (and reauthorized in 2002 for another 20 years) through the Connecticut River Atlantic Salmon Compact (Public Law 98-138). The Vermont Fish and Wildlife Department is a CRASC member agency, and a senior biologist from the department serves on the Technical Committee.

The Connecticut River Atlantic Salmon Commission developed *A Management Plan for American Shad in the Connecticut River* in 1992. Management Objectives in the plan include the following:

1. Achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually.
2. Maximize outmigrant survival for juvenile and spent adult shad.

The Atlantic States Marine Fisheries Commission *Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management*), approved in 2010 includes the following objective:

- Maximize the number of juvenile recruits emigrating from freshwater stock complexes.

and Recommendation:

- To enhance survival at dams during emigration, evaluate survival of post spawning and juvenile fish passed via each route (e.g., turbines, spillage, bypass facilities, or a combination of the three) at any given facility, and implement measures to pass fish via the route with the best survival rate.

The Agency seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.

2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to American shad, the Agency's goals are:

- Minimize current and potential negative project operation effects on juvenile American shad survival, production, and recruitment.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq*.), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq*.), Silvio O. Conte National Fish and Wildlife Refuge Act (P.L. 102-212; H.R. 794), the Federal Power Act (16 U.S.C. §791a, *et seq*.), the Atlantic States Marine Fisheries Compact (P.L. 539, 77th Congress, as amended by P.L. 721, 81st Congress), and the Atlantic Coastal Fisheries Cooperative Management Act (16 U.S.C. 5107).

Public Interest Consideration

The requestor is a resource agency.

Existing Information

Since the construction of the Turners Falls Dam upstream fishways in 1980, American shad have had access to spawning and rearing habitat upstream of Turners Dam. A number of modifications to the Turners Falls fishways have occurred since that time, with the numbers of adult shad passed at Gatehouse Ladder (into Turners Falls Dam impoundment) reaching as much 60,089 in 1992 when a record 721,764 shad passed upstream of Holyoke Dam. However, since 1980 an average of only 3.6 % of the adult shad passed upstream of Holyoke Dam subsequently have passed upstream of Turners Falls Dam, and this value has never exceeded 11%. This value is well below the CRASC 1992 Shad Plan objective of 40-60% passage from the previous dam. In addition, population number and passage numbers past Holyoke have declined substantially, with the average Holyoke passage number over the last 10 years being 211,850. Because historic data suggests that approximately half the returning adult shad to the Connecticut River pass the Holyoke Dam, recent adult returns are far below management goals. Effective upstream and downstream passage and successful in-river spawning and juvenile production are necessary to help achieve shad management restoration goals for the Connecticut River, which extends to the Bellows Falls Dam. In 1990, FirstLight's predecessor, Northeast Utilities, CRASC and its member agencies, signed an MOA on downstream fish passage to address both juvenile and adults at the Turners Falls Project and Northfield Mountain Pumped Storage Project.

American shad broadcast spawn with the highest spawning activity occurring in runs and lowest activity in pools and riffle/pools (Ross et al. 1993). Field research by Ross et al. (1993) in the Delaware River further noted that a combination of physical characteristics that seems to be avoided by spawning adults is slow current and greater depth. American shad year-class strength has been shown to depend on parent stock size and environmental conditions during the larval life stages (Creeco and Savoy 1984). Delays in juvenile American shad outmigration may affect survival rates in the transition to the marine environment (Zydlewski et al. 2003). One published study on the Connecticut River, identified that juvenile shad outmigration began when declining autumn temperatures reached 19C and peaked at 16C (O'Leary and Kynard 1986).

Juvenile American shad production has been monitored upstream of the Vernon Dam and immediately downstream of that dam by Vermont Yankee Nuclear as part of an annual monitoring program using both boat electrofishing (since 1991) and beach seining (since 2000). Sampling of juvenile shad was also conducted by a contractor hired by Northeast Utilities in the Turners Falls impoundment in 1992. O'Donnell and Letcher (2008) examined juvenile shad early life history and migration upstream and downstream of Turners Falls Dam. Their study results led to the decision by the agencies to require earlier operation of downstream fishways to protect early season juvenile shad out-migrants (1 September prior to 2010, 15 August in 2010, and since 2011, 1 August).

Downstream juvenile clupeid passage studies at Turners Falls were conducted in the fall of 1991 which included the objectives of determining the percentage of juvenile shad and herring that pass via the bypass log sluice or that were entrained in the Cabot Station turbines and related data (e.g., catch rates) were compared. The 1991 Downstream Clupeid Study did not assess survival rates for juveniles for either of these passage routes. The 1991 study report documented a higher rate entrainment into the project turbines (23.0 fish per minute) versus through the bypass sluice (11.6 fish per minute). It was concluded that only an estimated 54% (average bypass rate, weighted by estimated number bypassed) of the juvenile American shad approaching Cabot Station were bypassed via the log sluice. The range of the percent bypassed varied widely by date, between nearly 0 and 83%, with 'no clear explanation as to why." The report did not identify the percentage entrained into the turbines but it can be reasoned to be substantial based on the data presented in the report or assumed as the remaining balance (46%). as there were no spill events reported during this study, and therefore nowhere else for them to pass. It was further noted that entrainment rates for juveniles were consistently greatest for units 1 and 6 (ends), not uniform across all units. Although no concurrent bypass sampling occurred during the first entrainment sampling events, it was noted that "entrainment rates were relatively high during the end of September." Additional modifications have occurred over time without quantitative evaluation to improve downstream passage attraction and use to the bypass sluice, including lighting systems.

The 1994 Downstream Juvenile Shad Study report assessed juvenile shad survival from passage via the log sluice, reported to be 98%, based on tagged and recaptured fish (held for up to 48 hours). Scale loss (<20%) (22 of treatment fish) compared with scale loss of >20% (5 of treatment fish) was examined and determined to occur in an overall total of 10% of study fish (adjusted by control fish data).

Project Nexus
Adult American shad passed upstream of Turners Falls Dam utilize upstream spawning habitat. Juvenile American shad production occurs in these habitats upstream of Turners Falls Dam on an annual basis. Juvenile American shad require safe and timely downstream passage measures to have the opportunity to contribute to the fishery agencies' target restoration population size.

The Agency is not aware of any studies being conducted specifically designed to determine:

- When spill gates are open at the Turners Falls Dam?;
- What proportion of juvenile outmigrant shad take that route of passage?;
- What is the rate of survival under a range of spill and gate configurations?
- What is the timing, duration, and magnitude of juvenile shad outmigrants in summer and fall to the Turners Falls Dam and Gatehouse?
- Are there delays in migration/movement at the dam, Gatehouse, Cabot Station, or Station 1?
- For juveniles that enter the power canal, what proportion subsequently enter the Station 1 power canal?
- As there is no downstream passage facilities at Station #1, and trash rack spacing is 2.6 inches, what is the survival rate of juvenile shad entrained at Station #1?
- What is the rate of movement through the Turners Power Canal, relative to r delay to outmigrant juvenile shad and the potential accumulation of juveniles (e.g., prior to the canal drawdown in September)?
- What proportion of juvenile shad use the downstream sluice bypass versus the Cabot Station turbines under varied operational conditions given that project operations may change (PAD notes possible increase in turbine capacity at Cabot)?
- Based upon earlier facility studies (1991 Downstream Clupeid) a large proportion and number of juvenile shad are entrained into Cabot Station turbines. What are the associated impacts in terms of short-term and longer term survival and injury (i.e., scale loss)?

The Agency is concerned that project operations may impact juvenile shad outmigration survival and be contributing to the failure of the Connecticut River shad population to meet management targets. In the PAD, proposed modification include; Station 1 may be upgraded with new turbines, Station 1 may be closed, and/or the turbine capacity at Cabot may be increased. It is unclear how these scenarios will affect the questions identified in this request.

Proposed Methodology

The impact to juvenile shad outmigrants by project operations would be best studied by a combination of approaches including hydroacoustic, radio telemetry, and turbine balloon tags. Project discharge over a full range of existing and, to the extent possible, potential future operational conditions at Station 1 and Cabot, at the dam (likely increased bypass reach flows in new license) and in relation to the Gatehouse, should be examined relative to timing, duration, and magnitude of juvenile shad migration to and through these areas, with hydroacoustic equipment for natural/wild fish evaluation. In addition, study fish should be collected and tagged (PIT, radio, other mark, balloon) to also empirically determine rates of survival for fish passed over or through the dam's gates, under varied operations, including up to full spill condition that occurs annually in fall with canal outage period. The understanding of the timing, magnitude, duration of the wild fish outmigration will help inform the design, data/results, and assessment of tagged study fish. The release of tagged or marked fish (radio, PIT) upstream of the Gatehouse induction into the power canal, will provide data on concerns of delay and route selection to Station 1, Cabot Station downstream bypass, Cabot Station spill gates, and Cabot Station turbines. Additional hydroacoustic assessment at Cabot Station forebay will provide information on wild/natural juvenile fish timing, magnitude, and duration to and through this area. Based upon Year 1 study findings relative to the frequency, magnitude, timing of juvenile American shad that end up in the forebay of Station 1, the determination of whether an entrainment survival study at that site is necessary will be made. Release sites for tagged fish will be determined based upon further consultation among the parties.

Radio tagged juvenile shad will be released in areas upstream of the NMPS facility at multiple release locations, to determine operation effects on migration rates, route, orientation, entrainment, and survival, over a full range of permitted and operational conditions.

Level of Effort and Cost

First Light does not propose any studies to meet this need. Estimated cost for the study is expected to be high, between $200,000 and $300,000, with the majority of costs associated with equipment (hydroacoustic gear, radio tags, radio receivers, and PIT readers) and related fieldwork labor.

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Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 10: Shad population model for the Connecticut River

Goals and Objectives

Develop an American shad annual step, mathematical simulation population model for the Connecticut River to quantify how project operations and potential restoration/mitigation measures impact the population of shad in the Connecticut River.

The goal of the model is to assess impacts of both upstream and downstream passage at each of the Connecticut River projects and potential management options for increasing returns to the river.

Specific objectives include:

- Annual projections of returns to the Connecticut River;
- A deterministic and stochastic option for model runs
- Life history inputs of Connecticut River shad
- Understanding the effect of upstream and downstream passage delay at projects
- Calibration of the model with existing data
- Analysis of the sensitivity of model inputs
- Analysis of sensitivity to different levels of up- and downstream passage efficiencies at all projects
- Multiple output formats including a spreadsheet with yearly outputs for each input and output parameter

Resource Management Goals

The Agency's goals related to aquatic natural resources are to:

1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.

2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Vermont Fish and Wildlife Department's Strategic Plan (2002 -2010) focuses towards four major areas of concern: resource conservation, fish and wildlife-based recreation and use, human health and safety, efficient operations, and effective management.

The Connecticut River Atlantic Salmon Commission (CRASC) developed *A Management Plan for American Shad in the Connecticut River* in 1992. Management Objectives in the plan include the following:

1. Achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually.
2. Achieve annual passage of 40 to 60% of the spawning run (based on a 5-year running average) at each successive upstream barrier on the Connecticut River mainstem.
3. Maximize out-migrant survival for juvenile and spent adult shad.

The Service seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to American shad, the Service's goals are:

- Minimize current and potential negative project operation effects on American shad spawning and recruitment.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq*.), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq*.), and the Federal Power Act (16 U.S.C. §791a, *et seq*.).

Public Interest Consideration

The requestor is a resource agency.

Existing Information

Since the construction of the first fish lift facility at Holyoke Dam in 1967, American shad have had access to spawning and rearing habitat upstream from Holyoke Dam. A number of improvements to the Holyoke fishway have occurred since that time, but while the numbers of shad lifted at Holyoke have reached as much as 721,764 and the overall shad population to the river exceeded 1.6 million shad in 1992 (CRASC 1992), total shad populations, and numbers of shad passing Holyoke, Turners Falls and Vernon Dam have not met CRASC management goals.

Population and passage numbers past Holyoke have declined substantially from those totals in recent years, with average Holyoke passage numbers since 2000 of 229,876. Whole river population estimates have shown that approximately half of the returning population of shad pass upstream of Holyoke. Recent returns to Holyoke are far below management goals. Average passage efficiency of shad at Turners Falls (Gatehouse counts) and Vernon since 2000 has been 3.1 and 20.4 % respectively. These too are well below the CRASC management goals.

Safe, timely and effective up- and downstream passage along with successful spawning and juvenile production are necessary to help achieve shad management goals for the Connecticut River.

Project Nexus

Existing project operations and fish ladder efficiencies have a direct effect on shad populations in the Connecticut River. Poor upstream passage efficiencies and delays restrict river access to returning shad. Fish unable to reach upriver spawning grounds may not spawn or have reduced fitness or survival of young. Poor downstream passage survival and downstream passage delays affect outmigration and consequently repeat spawning, an important ecological aspect of the iteroparous Connecticut River shad population (Limberg et al. 2003).

The Service is concerned that poor passage efficiencies and delays at projects may be limiting access to upstream reaches of the river, altering spawning behavior, decreasing outmigration survival and contributing to the failure of the Connecticut River shad population to meet management targets (Castro-Santos and Letcher 2010).

Development of a population model will allow an assessment of individual project impacts on the population as well as the cumulative impacts of multiple projects. The model will allow managers to direct their efforts in the most efficient manner toward remedying the conditions that most impact the shad population.

Proposed Methodology

Population models are commonly used to assess anthropomorphic and natural impacts and are consistent with accepted practice. A model similar to this request was constructed for the Susquehanna River by Exelon (FERC #405, RSP 3.4). The model is constructed in Microsoft Access

Specific parameters that would be included in the model:

- Upstream passage efficiency at Holyoke, Turners Falls (Cabot, Gatehouse and Spillway Ladders), Vernon fishways, and any impacts associated with Northfield Mountain.
- Distribution of shad approaching the Turners Falls project between the Cabot Ladder and the spillway at the dam
- Downstream passage efficiencies at Vernon, Northfield Mountain, Turners Falls, and Holyoke projects for juveniles and adults
- Entrainment at Mount Tom and Vermont Yankee
- Sex ratio of returning adults
- The proportion of virgin female adults returning at 4, 5, 6, and 7 years

- The proportion of repeat spawning females at 5, 6 and 7 years
- Spawning success of females in each reach
- Fecundity
- Percent egg deposition
- Fertilization success
- Larval and juvenile in-river survival
- Calibration factor to account for unknown parameters such as at sea survival
- Options for fry stocking and trucking as enhancement measures
- Start year and model run years
- Start population
- Rates of movement to and between barriers
- Temperature, river discharge, and other variable of influence to migration and other life history events

The model should be adaptable to allow the input of new data and other inputs.

Level of Effort and Cost

Neither First Light nor TransCanada have proposed any study to meet this need. Estimated cost for the study is expected to be low to moderate. As the model describes the impacts of multiple projects and two owners, both project owners would share the cost of model development.

Literature Cited

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Bellows Falls Hydroelectric Project – FERC No. 1855-045
Vernon Hydroelectric Project – FERC No. 1904-073
Turners Falls Hydroelectric Project – FERC No. 1889-081
Northfield Mountain Pumped Storage Project – FERC No. 2485-063

Study Request 11: Impact of project operations on shad spawning, spawning habitat and egg deposition

Goals and Objectives

Determine if project operations (under the permitted and proposed operational ranges) affect American shad spawning site use and availability, spawning habitat quantity and quality, and spawning activity in the river reaches downstream from Cabot Station and in the project bypass reach of Turners Falls Dam, in the Turners Falls Dam impoundment and in relation to Northfield Mountain Pump Storage operations, downstream and upstream of the Vernon Dam, and in the project area downstream of Bellows Falls Dam. The following objectives will address this request:

- Determine areas utilized by American shad for spawning by conducting night-time visual observation of spawning activity, identify and define areas geospatially, and obtain data on physical habitat conditions effected by project operations (e.g., water depth, velocity, discharge, substrate, exposure and inundation of habitats);
- Determine project operation effects on observed spawning activity, under a range of permitted or proposed project operation conditions;
- Quantify effects (e.g., water velocity, depths, inundation, exposure of habitats) of project operation on identified spawning areas for a range of conditions, over the complete period of spawning activity;
- Quantify spawning activity as measured by night-time spawning/splash surveys and egg collection in areas of spawning activity, and downstream of these areas, to further determine project operation effects (location extent of exposure from changing water levels and flows and on associated habitats from project operations).

If it is determined that the Project operations are adversely affecting the spawning activity of American shad and impacting spawning area habitat, identify operational regimes that will reduce and minimize impacts spawning habitat and spawning success, within the project area. This study will require two years of field data to capture inter-annual variability to river discharge and water temperatures and to allow for evaluation of alternative flow regimes if year one studies determine that the present peaking regime negatively affects spawning.

Resource Management Goals

The Connecticut River Atlantic Salmon Commission (CRASC) was established by Congress in 1983 (and reauthorized in 2002 for another 20 years) through the Connecticut River Atlantic Salmon Compact (Public Law 98-138). The Vermont Fish and Wildlife Department is a CRASC member agency, and a senior biologist from the department serves on the Technical Committee.

The Connecticut River Atlantic Salmon Commission developed *A Management Plan for American Shad in the Connecticut River* in 1992. Management Objectives in the plan include the following:

1. Achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually.
2. Achieve annual passage of 40% to 60% of the spawning run (based on a 5-year running average) at each successive upstream barrier on the Connecticut River mainstem.

The Atlantic States Marine Fisheries Commission, Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management), approved in 2010 includes the following objective:

1. Maximize the number of juvenile recruits emigrating from freshwater stock complexes and recommendations:
2. To mitigate hydrological changes from dams, consider operational changes such as turbine venting, aerating reservoirs upstream of hydroelectric plants, aerating flows downstream, and adjusting in-stream flows.
3. Natural river discharge should be taken into account when instream flow alterations are being made to a river (flow regulation) because river flow plays an important role in the migration of diadromous fish.
4. Ensure that decisions on river flow allocation (e.g., irrigation, evaporative loss, out of basin water transport, hydroelectric operations) take into account instream flow needs for American shad migration, spawning, and nursery use, and minimize deviation from natural flow regimes.
5. When considering options for restoring alosine habitat, include study of impacts and possible alteration of dam-related operations to enhance river habitat.

The Agency's goals related to aquatic natural resources are to:

1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.

2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Vermont Fish and Wildlife Department's Strategic Plan (2002 -2010) focuses towards four major areas of concern: resource conservation, fish and wildlife-based recreation and use, human health and safety, efficient operations, and effective management.

The Agency seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to American shad, the Agency's goals are:

- Minimize current and potential negative project operation effects on American shad spawning and recruitment.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq*.), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq*.), Silvio O. Conte National Fish and Wildlife Refuge Act (P.L. 102-212; H.R. 794),The Federal Power Act (16 U.S.C. §791a, *et seq*.), The Atlantic States Marine Fisheries Compact (P.L. 539, 77th Congress, as amended by P.L. 721, 81st Congress), and the Atlantic Coastal Fisheries Cooperative Management Act (16 U.S.C. 5107).

Public Interest Consideration

The requestor is a state resource agency.

Existing Information

Since the construction of the first fish lift facility at Holyoke Dam in 1967, American shad have had access to spawning and rearing habitat upstream from Holyoke Dam. A number of improvements to the Holyoke fishway have occurred since that time, but while the numbers of shad lifted at Holyoke have reached as much as 721,764 and the overall shad population to the river exceeded 1.6 million shad in 1992 (CRASC 1992), total shad population, and numbers of shad passing Turners Falls and Vernon Dam have not met CRASC management plan objectives. Population number and passage numbers past Holyoke have declined substantially from those totals in recent years, with average Holyoke passage numbers over the last 10 years of 211,850. Since historically approximately half of the returning population of shad to the river passed upstream of Holyoke, recent returns are far below management goals. Effective upstream and downstream passage and successful in-river spawning and juvenile production are necessary to help achieve shad management goals for the Connecticut River.

American shad broadcast spawn in congregations over shallow flats and rocky or sandy substrates (Davis et al, 1970, Mansuetti and Kolb 1953), at depths less than 10 feet and often far shallower with spawning fish swimming vigorously near the surface in a closely packed circle (Marcy 1972, Mackenzie et al 1985). Fertilized eggs drift downstream until hatching (Mackenzie et al 1985).

American shad are known to spawn downstream from the Turners Falls Project. Layzer (1974) identified 6 spawning sites from an area below the mouth of the Deerfield River (river mile 191.9) to river mile 161.7 below the Mill River in Hatfield, MA. Kuzmeskus (1977) verified 16 different spawning sites ranging from downstream of the Cabot tailrace to just upstream of the Holyoke dam (river mile 87.1). The only parameter that all spawning sites had in common was current (Kuzmeskus 1977). The Agency is not aware of any more recent studies that document whether these 16 sites are still viable spawning locations for shad. We are not aware of any studies that have determined American shad spawning habitat or spawning sites upstream of Vernon Dam to Bellows Fall Dam (historic extent of upstream range).

First Light Power conducted studies in the late spring and summer of 2012, examined habitat conditions downstream of the Turners Falls Dam. The study documented that in low flow conditions, Cabot Station project operations produced fluctuations in water level elevations that can range over 4 feet in magnitude (daily operation) at the USGS Montague Gage Station, to lower values of 2 to 3 feet at the Route 116 Bridge, Sunderland, MA (PAD). Similar short-term, limited monitoring in the upper Turners Falls Dam impoundment identified water level changes due to project operations that d cyclically varied several feet on a sub-daily frequency.

Project Nexus

American shad are known to spawn at five locations downstream from the Turners Falls Project from an area below the mouth of the Deerfield River (river mile 191.9) and ten other locations downstream to river mile 161.7 below the Mill River in Hatfield (Layzer 1974, Kuzmeskus 1977).

Shad spawning is likely influenced by river flow, which fluctuates greatly due to the project's peaking mode of operation. These fluctuations may impact shad spawning activity by altering current velocities and water depth at the spawning sites. Effects on spawning behavior could include suspension of spawning activity, poor fertilization, flushing of eggs into unsuitable habitat due to higher peaking discharges, eggs dropping out into unsuitable substrate and being covered by sediment deposition and/or eggs becoming stranded on dewatered shoal areas as peak flows subside.

While a number of shad spawning and egg deposition studies were conducted in the 1970s, that research was aimed at assessing the potential impact of developing a nuclear power station in the Montague Plains section of the Connecticut River. The Agency is not aware of any studies being conducted specifically designed to determine if a relationship between spawning behavior, habitat use, and egg deposition and project operations effects of the Turners Falls, Northfield Mountain Pump Storage and Vernon projects and downstream of Bellows Falls Dam..

The Agency is concerned that peaking operations may be altering spawning behavior and contributing to the failure of the Connecticut River shad population to meet management targets.

Proposed Methodology

The first year of study should examine known spawning areas downstream of the Turners Falls Dam project, to determine operation effects on shad spawning behavior, activity, and success. In areas upstream of Turners Falls Dam to the Bellow Falls Dam tailrace, the study should identify areas utilized for spawning by American shad. In the second year, should results from year one determine project operations affected spawning activity, access to habitat, or success, downstream of Turners Falls Dam, then an identical more detailed assessment (identified objectives) should be conducted in spawning areas upstream of Turners Falls Dam to the Bellows Falls Dam tailwater. Measures to reduce or eliminate any documented project operation impacts should be explored and evaluated in year two, downstream of Turners Falls Dam.

The impacts to spawning behavior would best be studied by night-time observations of actual in-river spawning behavior (Ross et al. 1993). Project discharge increases or decreases during actual observed spawning activity will provide empirical evidence of change in behaviors. The observational methodology should follow the protocol specified in Layzer (1974) and/or as described in Ross et al. (1993). The analysis should utilize the observational field data in conjunction with operational data from the projects (station generation and spill on a sub-hourly basis). To assess the impacts of changes in generation flows, the study should include scheduled changes in project operation to ensure that routine generation changes that occur during the nighttime spawning period affect downstream spawning habitats selected for study while shad are spawning. Stier and Crance (1985) provide optimal water velocities during spawning to range between 1 to 3 ft/sec.

In areas used for spawning, the characteristics of those areas (e.g., location, depth, flow, substrate) should be recorded. The effect of project operations (discharge, water velocity, inundation and exposure) should be assessed. Drift nets will be used to collect eggs to quantify egg production before and after flow changes at the spawning site.

In the reaches above the Turners Falls dam, night time observations of splashing associated with shad spawning should be done in each reach as sufficient numbers of shad are passed above each dam. Observations should be done regularly until the end of the spawning season. The use of radio-tagged adult shad from a separate Study Request will aid in this effort. An estimate of the total area used for spawning and an index of spawning activity should be recorded for each site.

Level of Effort and Cost

Neither First Light or TransCanada propose any studies to meet this need. Estimated cost for the study is expected to be moderate (up to $40,000) for each owner, with the majority of costs associated with fieldwork labor.

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Atlantic States Marine Fisheries Commission. 2010. Amendment #3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management). Washington, D.C.

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Vernon Hydroelectric Project – FERC No. 1904-073
Turners Falls Hydroelectric Project – FERC No. 1889-081
Northfield Mountain Pumped Storage Project – FERC No. 2485-063

Study Request 12: Telemetry study of upstream and downstream migrating adult American shad to assess passage routes, effectiveness, delays, and survival

Goals and Objectives

Assess behavior, approach routes, passage success, survival, and delay by adult American shad as they encounter the projects during both upstream and downstream migrations, under permitted project operations conditions, proposed operational conditions, and study treatment operational conditions at First Light Power's Turners Falls and Northfield Mountain Pumped Storage projects and TransCanada's Vernon Project. There are multiple fishways and issues related to both upstream and downstream passage success at the projects. Some of these issues at the Turners Falls Project are similar to and/or pertain directly to the Northfield Mountain and Vernon projects. Therefore, it is reasonable to address passage issues at all projects in a similar manner.

<u>Telemetry Study -</u> This requested study requires use of radio telemetry using both radio and Passive Integrated Transponder (PIT) tag types to provide information to address multiple upstream and downstream fish passage issues. The following objectives shall be addressed in these studies:

- Assessment of any migration delays resulting from the presence of the dam and peaking flow operations of the Turners Falls Project;
- Determine route selection and behavior of upstream migrating shad at the Turners Falls Project under various spill flow levels (e.g., movement to the dam, attraction to Cabot Station, attraction to Station 1 discharge, movement between locations, delay, timing, etc.). A plan and schedule for dam spill flow releases will need to be developed that provides sufficient periods of spill flow conditions, and various generating levels from Turners #1 Station coupled with Cabot Station generation flows (e.g., treatments will require multiple days of consistent discharge). Evaluated spill flows should include flows between 2,500 – 6,300 cfs, which relate to bypass flows identified as providing spawning opportunities for shortnose sturgeon in the lower bypass reach at the Rock Dam. (Kieffer and Kynard 2012). Sturgeon spawning and upstream shad passage occur concurrently;
- Assess near field, attraction to and entrance efficiency of the Spillway Ladder by shad reaching the dam spillway, under a range of spill conditions;
- Evaluate the internal efficiency of the Turners Falls Spillway Ladder;
- Continue data collection of Cabot Station Ladder and Gatehouse Ladder efficiency, to include rates of approach to fishway entrances, entry into fishways, and passage through them, under different operational conditions that occur in these areas;
- Evaluate modifications to the Cabot and/or Spillway fishways recommended by the Service if they are implemented;

- Assess upstream migration from Turners Falls to the Vernon Dam in relation to Northfield Mountain's pumping and generating operations and Vernon Project peaking generation operations. Typical existing and proposed project operation alterations should be evaluated;
- Assess near field, attraction to and entrance efficiency of the Vernon Dam Ladder;
- Assess internal efficiency of the Vernon Dam Ladder;
- Assess upstream passage past Vermont Yankee's thermal discharge (also located on the west bank of the river 0.45 mile upstream of fish ladder exit)
- Assess upstream migration from Vernon Dam in relation to the peaking generation operations of the Bellows Falls Project. Typical existing and proposed project operation alterations should be evaluated;
- Determine post-spawn downstream migration route selection, passage efficiency, delays and survival related to the Vernon Project, including evaluation of the impact of the Vermont Yankee heated water discharge plume on downstream passage route, migrant delay/timing, efficiency and survival;
- Assess impacts of Northfield Mountain operations on up- and downstream adult shad migration, including delays, entrainment, and behavioral changes and migration direction shifts under existing and proposed project operations;
- Determine downstream passage route selection, timing/delay, and survival under varied project operational flows into the power canal and spill flows at Turners Falls Dam;
- Determine downstream passage route selection, timing/delay in the canal, Cabot Station fish bypass facility effectiveness, and survival of Cabot-bypassed adult shad that enter the Turners Falls Canal system;
- Compare rates and or measures of delay, movement and survival etc., among project areas or routes utilized (e.g., spill at dam vs. power canal) under the range of permitted and proposed conditions; and
- Utilize available data sets and further analyze raw data (e.g., 2003- 2012 Conte Lab Studies) where possible to address these questions and inform power analyses and experimental design.

Information to address all of these questions would rely on the tagging of upstream migrating adult shad at Holyoke Dam and releasing them to migrate naturally from Holyoke through the Turners Falls and Vernon projects and back downstream after spawning. Additional tagged individuals would likely need to be released farther upstream (Turners Falls Canal, upstream of Turners Falls Dam, and upstream of Vernon Dam), to ensure that enough tagged individuals encounter project dams on both upstream and downstream migrations, that these individuals are exposed to a sufficient range of turbine and operational conditions to test for project effects, and to provide adequate samples sizes for statistically valid data analyses to address the many objectives listed. This study will require two years of field data collection to attempt to account for inter-annual variability in river discharge and water temperatures.

<u>Evaluation of Past Study Data</u>- In addition to collection and analysis of new telemetry data, substantial data has already been collected at Turners Falls from multiple years of passage assessments conducted for First Light by U.S. Geological Survey's Conte Anadromous Fish Research Center (Conte Lab) researchers and there are also data from the 2011 and 2012 full river study conducted by the Conte Lab that address Turners Falls, Northfield Mountain and

Vernon project migration and passage questions that have not yet been analyzed. These data include several million records each year from more than 30 radio telemetry receivers deployed between Middletown, CT and Vernon Dam. This data will provide substantial information free from the field data collection costs and therefore should be analyzed as part of this study. This data analysis should be completed in 2013 to help inform the design of subsequent field studies.

<u>Evaluation of Methods to Get Shad Past Cabot Station for Spillway Passage at the Turners Falls Dam</u> – The poor passage efficiency of the Cabot Ladder, the first and most used fishway encountered by shad arriving at the Turners Falls Project, and at the entrance to the Gatehouse Ladder, which all Cabot fishway-passed fish must use, has resulted in very poor overall shad passage efficiency at the project. An alternative to passing fish at the Cabot Station is to install a fish lift at the dam that would put fish directly into the Turners Falls pool, thereby eliminating problems with the Cabot Fishways, and the Gatehouse Fishway entrance and the variable passage efficiency of the Gatehouse Fishways. For this to be effective, attraction of shad to the Cabot Station discharge and associated delays would need to be overcome. It is possible that spillway flow releases coupled with behavioral measures at Cabot Station that dissuade shad from that tailrace could achieve this end. In order to assess the possibilities, we recommend the following study:

1. A literature search and desk-top assessment of the possible behavioral measures that could be effective in getting shad to pass Cabot Station tailrace and continue upstream to the dam.

2. Based on results of the desk-top assessment, possible evaluation of behavioral measures that are likely to be effective.

3. Field evaluation of the effect of different levels of spill at the dam that would induce fish to move past the Cabot Station into the bypass reach and up to the dam (as noted in objectives).

Besides passage success and delays at passage facilities, these studies would assess the impacts of project operations on migration passage delay, route, timing, injury, mortality, and passage structure attraction, retention, and success. Of particular interest will be fish behavior during periods when flow releases from the project increase from the required minimum flows to peak generation flows and when flows subside from peak generation flows to minimum flows and the operation of NMPS in pumping and generation modes.

Resource Management Goals

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat.

The Agency's goals related to aquatic natural resources are to:

1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.

2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:
1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Vermont Fish and Wildlife Department's Strategic Plan (2002 -2010) focuses towards four major areas of concern: resource conservation, fish and wildlife-based recreation and use, human health and safety, efficient operations, and effective management.

The Connecticut River Atlantic Salmon Commission (CRASC) was established by Congress in 1983 (and reauthorized in 2002 for another 20 years) through the Connecticut River Atlantic Salmon Compact (Public Law 98-138). The Vermont Fish and Wildlife Department is a CRASC member agency, and a senior biologist from the department serves on the Technical Committee. The CRASC developed *A Management Plan for American Shad in the Connecticut River* in 1992. Management Objectives in the plan include the following
1. Achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually. (Table 1)
2. Achieve annual passage of 40 to 60% of the spawning run (based on a 5-year running average) at each successive upstream barrier on the Connecticut River mainstem.
3. Maximize outmigrant survival for juvenile and spent adult shad.

The Atlantic States Marine Fisheries Commission, Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management), approved in 2010 includes the following objective:

- Maximize the number of juvenile recruits emigrating from freshwater stock complexes and recommendations:

Upstream Passage –
1. American shad must be able to locate, enter, and pass the passage facility with little effort and without stress.
2. Where appropriate, improve upstream fish passage effectiveness through operational or structural modifications at impediments to migration.
3. Fish that have ascended the passage facility should be guided/routed to an appropriate area so that they can continue upstream migration, and avoid being swept back downstream below the obstruction.

Downstream Passage –

- To enhance survival at dams during emigration, evaluate survival of post spawning and juvenile fish passed via each route (e.g., turbines,, spillage, bypass facilities, or a combination of the three) at any given facility, and implement measures to pass fish via the route with the least delay and best survival rate.

Based on the CRASC plan, the Agency seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to American shad movement and migration, the Agency's goals are:

- Minimize current and potential negative project operation effects such as migration delays, false attraction, turbine entrainment, survival of project passage routes, and trashrack impingement that could hinder management goals and objectives.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq*.), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq*.), Silvio O. Conte National Fish and Wildlife Refuge Act (P.L. 102-212; H.R. 794), the Federal Power Act (16 U.S.C. §791a, *et seq*.), the Atlantic States Marine Fisheries Compact (P.L. 539, 77th Congress, as amended by P.L. 721, 81st Congress), and the Atlantic Coastal Fisheries Cooperative Management Act (16 U.S.C. 5107).

Public Interest Consideration

The requestor is a state natural resource agency.

Existing Information

Passage of adult shad at the Turners Falls fishway complex has been the subject of intense study by the Conte Lab since before 1999. These studies have clearly demonstrated that passage through the existing fishways at Cabot and Spillway is poor (<10% in many years). Passage through the Gatehouse fishway is better, but still rarely exceeds 80%, despite the short length of this ladder. In addition to poor passage for fish entering the ladders, shad that ascend the Cabot Fishway experience extensive delays before entry into the Gatehouse Fishway. Shad that ascend Spillway frequently fall back into the canal and are also subject to these upstream delays. A new entrance to the Gatehouse Fishway installed in 2007 led to dramatic improvements in passage out of the canal (from 5% to over 50% in 2011), but passage still falls well short of management goals. In addition, shad spend considerable time (up to several weeks) attempting to pass. These delays likely influence spawning success and survival. Adult shad, unable to pass Gatehouse, experience similar delays in downstream passage, even after they have stopped trying to pass

Gatehouse. Without spill, all outmigrating shad that have passed Gatehouse must enter the canal at the Gatehouse and may be subject to delays exiting the canal.

During the course of these studies a very large dataset has been compiled that could yield useful information for further improving passage of shad out of the canal in both the upstream and downstream directions. A unique feature of these data is a 2-dimensional array covering the canal just downstream of Gatehouse, documenting fine scale movements and occupancy of this zone. These data should be combined with computational fluid dynamics (CFD) and real-time hydraulic data to determine how canal hydraulics influence the ability of shad to locate and enter the fishway, and to identify modifications that are likely to lead to improvements in approach and entry rates. A separate CFD modeling study is requested that includes modeling of the Gatehouse Fishway entrance are at the head of the power canal.

In addition, whole-river shad telemetry studies performed in 2011 and 2012 will likely provide useful information and should be analyzed. These data should allow quantification of delay below Turners Falls, and could help guide studies requested above. Preliminary analyses of data through 2011 have been made available to FirstLight and the resource agencies (Castro-Santos and Haro 2005; Castro-Santos and Haro 2010).

The whole-river studies have also shown that, at least in 2011, most shad that pass Turners Falls rapidly progress upstream to Vernon Dam where extensive delays also occur. Data from the 2012 study were not available at this time, but Dr. Castro-Santos stated similar patterns were noted in the data between the years on the topic of upstream delay (personal communication, Dr. Theodore Castro-Santos). Similarly, concerns relative to the downstream passage of spent shad also remain relative to delays, with existing unpublished USGS telemetry data sets suggesting this is an issue within the Turners Falls canal.

Since the first year of operation of the Turners Falls upstream fishways (1980), the percent passage of American shad annually passed upstream of Turners Falls Dam compared to the number passed at the Holyoke Fish Lift has averaged 3.6% (1980-2012 data). The highest values for this metric has not exceed 11% and are well below the noted CRASC Management Plan target range for this objective noted earlier as 40-60% on a five year running average.

Since the first year of operation of the Vernon Dam upstream fish ladder (1981), the percent passage of American shad annually passed at Vernon compared to the number passed upstream of Turners Falls Dam (Gatehouse counts) has averaged 39.4%, ranging from 0.42% to 116.4% (> 100% due to counting error at one or both facilities, unknown).

Project Nexus

Existing project operations (peaking power generation) and limited bypass flows have a direct impact on instream flow and zones of passage (migration corridors). Project flow releases affect passage route selection, entry into fishways, and create delays to upstream migration. Inefficient downstream bypasses can result in migration delays and increased turbine passage. Mortality of adult shad passing through these turbines is expected to be high (Bell and Kynard 1985), additional stresses associated with passage and delay may cause mortality as shad are unable to return to salt water in a timely manner. The project's upstream and downstream passage facilities need to be designed and operated to provide timely and effective upstream and downstream fish passage to meet restoration goals of passage to upstream habitat and maximize post-spawn survival. These factors are all critically important to the success of restoration efforts.

Proposed Methodology

Use of radio including passive-integrated transponder (PIT) telemetry is widely accepted as the best method to assess fish migratory behavior and passage success and has been used extensively to assess migration and passage issues at Turners Falls as well as other Connecticut River projects. These studies include one conducted in 2011 and 2012 by the Service and U.S. Geological Survey's Conte Anadromous Fish Research Center, which has provided substantial information related to some of the issues identified here. The requested study will build and expand on the information collected over the past two years.

The study design must specify sample sizes, tag configurations and receiver configurations, to ensure that rates of entry and exit to the tailraces, fishways, downstream bypasses, and the bypassed reach can be calculated with sufficient precision to determine effectiveness of flow and ensonification treatments (separate Study Request). For project assessments at Turners Falls (e.g., Cabot, Spillway and Gatehouse ladder attraction and entry, route selection, operational effects), double tagged (radio and PIT) shad will be required for release from Holyoke Dam. Additional shad must be released directly into the Turners Falls Canal to support assessment of the various operational and structural conditions in effect, to be modified in this period, and proposed conditions within the Turners Falls power canal relative to entrances to the Gatehouse fishway. A related request on CFD modeling in the Cabot Station tailrace, the upper power canal near Gatehouse, and in the area around the entrance of the Spillway Ladder will address related project operational effects that will also address identified objectives in this telemetry request. Shad captured at Holyoke and tagged and release upstream of Turners Falls Dam, or tagged out of Gatehouse Ladder, would help to ensure an adequate sample size for evaluations in the vicinity of NMPS and to the Vernon Dam and the ability to address identified study objectives in those project areas. Additional tagged shad are expected to be required for release upstream of the Vernon Dam, which should ensure adequate sample for a separate study request, where shad spawn upstream of Vernon Dam as well as ensuring there is an adequate number of outmigrating spent adults to address related study objectives for adult outmigrants. The required number of tagged fish to address study objectives may be adjusted accordingly from area to area depending on target numbers (i.e., best information on resultant viable tagged fish and power analyses to detect effects) to account for typical passage rates, survival rates, and handling effects as examples.

Existing information on captured, handled, tagged fish performance (e.g., percent that drop back, unsuitable for tracking) and factors such as timing of tagging and potentially transport, must all be carefully considered to ensure an adequate sample size of healthy (e.g., viable to characterize behavior, survival, etc.) tagged fish is available to address the many questions identified in this request (as supported by a statistical power analysis). Additionally, ensuring adequate downstream adult fish sample sizes (to address project effect questions above) requires close consideration as expected losses of healthy tagged fish during upstream passage, natural mortality rates, and tagging related effects, are expected to reduce sample sizes on downstream passage objectives/questions as the season progresses. The use of single PIT tagged fish can help improve sample sizes, but will be of limited use to answer some of the passage questions we have identified.

Due to environmental variability, two years of study work will be necessary. A large array of stationary monitoring stations (radio and PIT) will be needed to address the issues identified among the project areas. A sufficient level of radio receiver and PIT reader coverage will be required, to provide an appropriate level of resolution, for data analyses, to answer these questions on project operational effects. The study will provide information on a variety of structural and operational aspects of fish migration, relative to route selection, timing, survival, and up and downstream passage attraction, retention, delay, efficiency, survival as some examples at three projects (Turners Falls, NMPS, and Vernon). The use of video monitoring may also be utilized for specific study areas such as the Spillway Ladder, to provide additional information on shad entrance activity, with the understanding of some data limitations associated with this approach (fish identification, water visibility). This study will be coordinated with the proposed study request to evaluate ensonification as a shad behavioral deterrent at the Cabot Station tailrace which will be an additional treatment of the telemetry study.

In addition to the tagging studies, use of video monitoring of the Spillway Fishway would provide additional overall data on Spillway Fishway efficiency as all shad attempting to pass could be monitored versus just those shad that have been tagged.

Level of Effort and Cost

The requested study is extensive and will require a substantial effort and cost to capture, PIT tag, and radio tag a sufficient number of shad at Holyoke to release at upstream locations. We are not aware of any other study technique that would provide project specific fish behavior and migration information to adequately assess existing project operations and provide insight in possible alternative operations and measures needed to address observed negative impacts to fish migration success. Cost for the entire multi-project tagging, tracking and data analysis are expected to range from $400,000 to $500,000 based on past Turners Falls' studies and the 2011 and 2012 shad telemetry studies. Video monitoring of the Spillway fishway would add a modest cost to this study.

Due to the fact tagged shad will move throughout the larger five project area, to varying degrees, there will be expected cost savings (e.g., radio tags) to both owner/operators, provided cooperation in study planning and implementation occurs.

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Wilder Hydroelectric Project – FERC No. 1892-026
Bellows Falls Hydroelectric Project – FERC No. 1855-045
Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 13: Fish assemblage in project-affected areas

Goals and Objectives
The goal of this study request is to determine the occurrence, distribution, and relative abundance of fish species present in the project-affected areas of the Vernon, Bellows Falls and Wilder Projects, which potentially includes Species of Greatest Conservation Need (SGCN) for both New Hampshire and Vermont.

Specific objectives include:
1) Document fish species occurrence, distribution and abundance within the project-affected areas along spatial and temporal gradients.

2) Compare historical records of fish species occurrence in the project-affected areas to results of this study.

Resource Management Goals
The Agency's goals related to aquatic natural resources are to:
1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Vermont Fish and Wildlife Department's Strategic Plan (2002 -2010) focuses towards four major areas of concern: resource conservation, fish and wildlife-based recreation and use, human health and safety, efficient operations, and effective management.

Riverine fish species are an important component of the river's ecology and are the basis for the sport fishery. Furthermore, several of the states' SGCN have been documented in the project-affected area.

Determining species occurrence, distribution and abundance will help address research and monitoring needs for species whose populations are poorly known. For example, as outlined in Vermont's Wildlife Action Plan (Kart et al.2005), research and monitoring needs for SGCN include monitoring and assessing populations and habitats for current conditions and future changes, and identifying and monitoring problems for species and their habitats.

A study that aims to provide a comprehensive investigation that documents which fish species are utilizing the project-affected areas in relation to spatial, temporal and environmental gradients (i.e. temperature, dissolved oxygen, pH, turbidity) will allow for a fuller understanding and examination of potential impacts that the Vernon, Bellows Falls and Wilder Project's operations have on the species that reside there. As noted below, there is little information concerning riverine fish in the project-affected areas as related to this study request.

Public Interest Consideration

The requestor is a state natural resource agency.

Existing Information

A thorough and comprehensive assessment of the fish assemblage present in the project-affected areas of the Bellows Falls and Wilder Projects is lacking. The PAD for the Bellows Falls Project acknowledges that, "Little comprehensive information is available regarding characterization of the fish community in relation to the Project." The PAD for the Wilder Project states, "No targeted studies have been conducted to characterize the fish community in relation to the Project."

The most relevant fish study related to the Bellows Falls and Wilder project-affected areas is a Connecticut River electrofishing survey conducted in 2008 (Yoder et al., 2009). While some sampling was conducted in both project-affected areas during the 2008 survey, this survey did not have the same goals and objectives as those outlined above. Additionally, both the Bellows Falls and Wilder PADs acknowledged that fish species assemblage data are limited and that the synthesized data may not be a full representation of species occurrence in the project-affected areas. Although, fish data has been collected by Vermont Yankee for many years in the Vernon Dam project-affected area, objectives and methodology for those fish surveys differ from those stated here, and gear types were generally limited to boat electrofishing which may not be suitable for properly assessing all species present in the project-affected areas. It is unknown if other species may inhabit or utilize aquatic habitats in the projects area that to this date have not been documented by previous surveys. It follows that without more information on the fish community in the project-affected areas, project impacts on fish species are also unknown.

Project Nexus

Project operations have the potential to directly impact fish species life history requirements, biological interactions, and habitat quantity and quality. For example, headpond and tailwater water level fluctuations could dewater important spawning areas or change available habitat, thus limiting productivity of important game fish species by direct impacts to their spawning success or indirectly by limiting the spawning success of forage fish species. Furthermore, several of New Hampshire and Vermont's SGCN have been documented in the project-affected area. Accordingly, a thorough understanding of the current fish assemblage structure and associated metrics are needed in order to examine any potential project-related impacts.

Proposed Methodology

An accepted and robust field sampling design (e.g., as described in Pollock et al. 2002 or MacKenzie et al. 2006) and accepted methods for collecting fish species likely to be present in the project-affected areas (Bonar et al. 2009) should be used to conduct field surveys. Randomly sampling multiple habitat types using a multi-gear approach will be required to ensure that all fish species present are sampled. The spatial scope of the study will be from the most upstream area influenced by the Wilder Dam to the most downstream area influenced by the Vernon Project. Sampling should occur at each selected site across multiple seasons (spring, summer, and fall). Digital photographs should be taken to avoid misidentifying certain species such as Cyprinids.

The sampling design should include replicate samples for estimation of species detection probability. Sample replicates may be gathered temporally, using different methods, by independent observers, or by randomly sampled spatial replicates (MacKenzie et al. 2006). For each replicate sample, data that may be important for describing variation in species occurrence and presence/absence should be collected and recorded, such as gear type, mesohabitat type, depth, velocity, flow, water temperature, substrate, time of day, day of year, presence of cover, proportion of vegetation cover, size of individuals collected (juveniles may select different habitat), and other factors as determined by a qualified biologist. Species detection, occurrence, and/or abundance as related to these parameters should be estimated using methods as described by Kery et al. (2005), MacKenzie et al. (2006), Wenger and Freeman (2008), or Zipkin et al. (2010).

Based on first year study results, specific studies examining impacts of project operations on specific fish species may be requested. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

Level of Effort and Cost

The cost of the study will be moderate to high as seasonal sampling with several types of gear will be required. However, cost will also be partially dependent on the number of sites sampled, the number of sample replicates, and the extent of the covariate data that are measured. Provided the collected data are of high quality, analysis and synthesis should take approximately 10-20 days. TransCanada did not propose any studies specifically addressing this issue

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Turners Falls Hydroelectric Project – FERC No. 1889-081
Northfield Mountain Pumped Storage Project – FERC No. 2485-063

Study Request 13: Fish assemblage in project-affected areas

Goals and Objectives
The goal of this request is to determine the occurrence, distribution, and relative abundance of fish species present in the Project affected areas of the Turners Falls and Northfield Mountain Project Areas, which potentially includes Species of Greatest Conservation Need (SGCN) for Massachusetts, New Hampshire, and Vermont.

Specific objectives include:
1) Document fish species occurrence, distribution and abundance within the project affected area along spatial and temporal gradients.

2) Compare historical records of fish species occurrence in the project affected area to results of this study.

Resource Management Goals
The Agency's goals related to aquatic natural resources are to:
1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:
1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Vermont Fish and Wildlife Department's Strategic Plan (2002 -2010) focuses towards four major areas of concern: resource conservation, fish and wildlife-based recreation and use, human health and safety, efficient operations, and effective management.

Riverine fish species are an important component of the river's ecology and are the basis for the sport fishery. Furthermore, several of the states' SGCN have been documented in the project-affected area.

Determining species occurrence, distribution, and abundance will better clarify what species occur in the project area both spatially and temporally, relative to habitats which may be affected by project operations of the Turners Falls or Northfield Mountain Pump Storage projects. This information will better inform other results from other study requests that will be examining project operation effects on various aquatic habitats, water quality and other related concerns such as entrainment concerns at NFMPS. This information will be used to make recommendations and provide full consideration for all species, including those that might not otherwise be known to occur in the project-affected area and impacts that may affect their population status through direct or indirect effects of the projects.

Public Interest Consideration
The requestor is a natural resource agency.

Existing Information
A thorough and comprehensive assessment of the fish assemblage present in the project-affected areas of the Turners Falls and NFMPS projects is lacking. The PAD for these projects sites notes resident fish surveys conducted by the State of Massachusetts in the early to mid 1970s and a limited 2008 sampling effort by Midwest Biodiversity Inst. (contracted by EPA). The PAD identifies a total of 22 fish species in the project area which omits, as an example of its limited information basis, northern pike, tessellated darter, burbot, eastern silvery minnow, and channel catfish (Ken Sprankle, USFWS, and Jessie Leddick, MADFW, personal communication). It is unknown how many other species may inhabit or utilize aquatic habitats in the projects area, potentially including species of greatest conservation need.

The most relevant recent fish survey study related to the project affected areas is a Connecticut River electrofishing survey conducted in 2008 (Yoder et al., 2009). While some sampling was conducted in both project areas during the 2008 survey, this survey did not have the same goals and objectives as those outlined above. Due to the design of the study limitations in geographic/habitat type coverage both spatially and temporally, and the use of a single gear type, limits the use of these data and that synthesized data may not be a full representation of species occurrence in the project affected areas. It follows that since information is limited regarding the composition of the fish community and their use of habitats in the project-affected area, project impacts on fish species are also unknown.

Project Nexus
Project operations have the potential to directly impact fish species life history requirements, biological interactions, and habitat quantity and quality. For example, headpond and tailwater water level fluctuations could dewater important spawning areas, or affect habitat availability, thus limiting productivity of fish species by direct impacts to their spawning success or indirectly by limiting the spawning success of forage fish species. Accordingly, a thorough understanding of the current fish assemblage structure and associated metrics are needed in order to examine any potential project-related impacts. A Study Request to examine project effects on aquatic

habitats, as well as impacts to spawning habitats (e.g., sea lamprey and black bass) has been submitted and will compliment this request.

Proposed Methodology

An accepted and robust field sampling design (e.g., as described in Pollock et al. 2002 or MacKenzie et al. 2006) and accepted methods for collecting fish species likely to be present in the project-affected areas (Bonar et al. 2009) should be used to conduct field surveys. Randomly sampling multiple habitat types using a multi-gear approach will be required to ensure that all fish species present are sampled. The spatial scope of the study will be from the headwaters of the Turners Falls pool downstream to Sunderland, Massachusetts, and will omit the upper reservoir of Northfield Mountain Pump Storage Project. Sampling should occur at each selected site across multiple seasons (spring, summer, and fall). Digital photographs should be taken to avoid misidentification of certain species such as Cyprinids.

The sampling design should include replicate samples for estimation of species detection probability. Sample replicates may be gathered temporally, using different methods, by independent observers, or by randomly sampled spatial replicates (MacKenzie et al. 2006). For each replicate sample, data that may be important for describing variation in species occurrence and presence/absence should be collected and recorded, such as gear type, mesohabitat type, depth, velocity, flow, water temperature, substrate, time of day, day of year, presence of cover, proportion of vegetation cover, size of individuals collected (juveniles may select different habitat), and/or other factors as determined by a qualified biologist. Species detection, occurrence, and/or abundance and related habitat measures on these parameters should be estimated using methods as described by Kery et al. (2005), MacKenzie et al. (2006), Wenger and Freeman (2008), or Zipkin et al. (2010).

This will be a one year study provided river discharge conditions fall within 25th to 75th percentile for weekly averages. Based upon this study's results, and the additional information obtained on requests to survey aquatic habitats and littoral zone fish spawning, an additional study may be required if evidence of project operation affects on population status or habitat for identified species.

Level of Effort and Cost

The cost of the study will be moderate to high as seasonal sampling with several types of gear will be required. However, cost will also be partially dependent on the number of sites sampled, the number of sample replicates, and the extent of the covariate data that are measured, all which may be flexible. Based on first year study results, a second year of sampling or specific studies examining impacts of project operations on specific fish species may be needed and requested. Provided the collected data are of high quality, analysis and synthesis should take approximately 10-20 days. FirstLight did not propose any studies specifically addressing this issue.

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Wilder Hydroelectric Project – FERC No. 1892-026
Bellows Falls Hydroelectric Project – FERC No. 1855-045
Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 14: Impacts of downstream water fluctuations on resident fish spawning

Goals and Objectives

The goal of this study is to determine if the full range of project induced flow and water level fluctuations in the project-affected areas below the Vernon, Bellows Falls and Wilder Dams negatively impact resident fish spawning (smallmouth bass, common white sucker, walleye and fallfish), and if impacts are found to occur, to develop appropriate mitigation measures.

Specific objectives include:
1) Conduct field studies in the project-affected areas downstream from the Vernon, Bellows Falls and Wilder Dams to assess timing and location of fish spawning. Nesting locations should be mapped.

2) Conduct field studies in the Project affected areas below the Vernon, Bellows Falls and Wilder Dams to evaluate potential impacts of the full range of project induced water level fluctuations on nest abandonment, spawning fish displacement and egg dewatering. The study should also evaluate if changes in fluctuation range would mitigate for identified impacts and/or if other mitigative measures would lessen these impacts.

Resource Management Goals

The Agency's goals related to aquatic natural resources are to:
1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Resident fish species are an important component of the river's ecology and in some cases are the basis for a sport fishery. This requested study will help protect and conserve resident fish species by ensuring Project operations do not negatively impact their spawning success.

Public Interest Consideration
The requestor is a resource agency.

Existing Information
To our knowledge, no information exists related to this requested study.

Project Nexus
Project operations have the potential to impact fish species by influencing spawning success and spawning habitat quality and quantity. For example, flow and water level changes due to Project operations could create conditions where fish eggs are exposed to air, where quality spawning habitat is dewatered, and/or where fish abandon nests containing eggs. A study of a regulated river found temporal fluctuations of streamflow appeared to be the most important abiotic factor determining smallmouth bass nesting success or failure (Lukas and Orth 1995). Similarly, other research suggests stream discharge during and immediately after spawning could be important to smallmouth bass recruitment success (Smith et al. 2005). Current can also impact early survival of walleye by moving eggs and larvae from spawning sites (Humphrey et al. 2012).

Proposed Methodology
Common tools to evaluate fish spawning would be used including electrofishing, visual observations, and telemetry. Specific areas of interest are locations in project-affected areas below the Vernon, Bellows Falls and Wilder Dams where it is determined that the before mentioned fish species spawn. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

Level of Effort and Cost
TransCanada does not propose any studies to meet this need. Estimated cost for the study is moderate.

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Wilder Hydroelectric Project – FERC No. 1892-026
Bellows Falls Hydroelectric Project – FERC No. 1855-045
Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 15: Upstream American eel survey

Goals and Objectives

The goal of this study is to provide baseline data relative to the presence of American eel upstream of the Vernon, Bellows Falls, and Wilder dams.

The objective of the study is to determine the relative abundance and distribution of American eel upstream of the Vernon, Bellows Falls and Wilder dams in both riverine and lacustrine habitat.

Resource Management Goals

The Agency's goals related to aquatic natural resources are to:

1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Vermont Fish and Wildlife Department's Strategic Plan (2002 -2010) focuses towards four major areas of concern: resource conservation, fish and wildlife-based recreation and use, human health and safety, efficient operations, and effective management.

The American eel (*Anguilla rostrata*), is listed as one of both New Hampshire's and Vermont's Species of Greatest Conservation Need (SGCN). The status for conservation need in Vermont is listed as high priority (Kart et al. 2005), and the species is listed as "vulnerable" in New Hampshire. As identified in Vermont's Wildlife Action Plan (Kart et al. 2005), threats to the species include the construction of large dams on rivers which obstruct juvenile fish access to critical rearing habitats, as well as mortality associated with passing through hydroelectric facilities' turbines during their outmigration to sea.

As outlined in Vermont's Wildlife Action Plan (Kart et al. 2005), research and monitoring needs for this SGCN include determining their distribution and abundance, as the contribution of eels in northern regions to overall stock is unknown. One of the conservation strategies for this species is to support efforts to enhance access of American eels to Vermont waters by eliminating or minimizing impacts of dams and other obstructions along the Richelieu, St. Lawrence, and Connecticut Rivers.

The Atlantic States Marine Fisheries Commission has developed two documents related to the management of American eel:

1. Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.

2. Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

Objectives of the management plan include: (1) protect and enhance American eel abundance in all watersheds where eel now occur; and (2) where practical, restore American eel to those waters where they had historical abundance but may now be absent by providing access to inland waters for glass eel, elvers, and yellow eel and adequate escapement to the ocean for pre-spawning adult eel.

Addendum II contains specific recommendations for improving upstream and downstream passage of American eel, including requesting that member states and jurisdictions seek special consideration for American eel in the FERC relicensing process.

The Connecticut River Atlantic Salmon Commission (CRASC) was established by Congress in 1983 (and reauthorized in 2002 for another 20 years) through the Connecticut River Atlantic Salmon Compact (Public Law 98-138). The Vermont Fish and Wildlife Department is a CRASC member agency, and a senior biologist from the department serves on the Technical Committee. The CRASC developed A Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin in 2005. The goal of the plan is "to protect and enhance the abundance of the American eel resource to ensure its continued role in the Connecticut River Basin ecosystem…" Management objectives in the plan include the following:

1. Protect and enhance eel populations where they currently exist;

2. Where practical, restore populations to waters where they had historical abundance;

3. Provide effective upstream and downstream fish passage around dams and other barriers within the species' range in the basin; and

4. Comply with all requirements of the Fishery Management Plan of the ASMFC.

Based on these plans, the Agency seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to American eels, the Agency's goals are:

3. Protect, enhance, or restore, diverse high quality aquatic and riparian habitats for plants, animals, food webs, and communities in the watershed and mitigate for loss or degradation of these habitats.
4. Understand the baseline condition with respect to the presence of American eel within and upstream of the project area.
5. Minimize current and potential negative project operation effects on American eel inhabiting the project area and/or moving through the area during upstream and downstream migrations

Our study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq*.), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq*.), and the Federal Power Act (16 U.S.C. §791a, *et seq*.).

Public Interest Consideration

The requestor is a resource agency.

Existing Information

According to the PADs, very few American eels were collected in the Fish Assemblage and Habitat Assessment of the Upper Connecticut River (Yoder et al., 2009). In the Vernon Project area upstream of the dam, only one eel was collected; no eels were collected from the Bellows Falls pool, and none were found upstream of the Wilder Dam. However, in 2012 over 200 eels were documented using the upstream fish ladder at the Vernon Project and the New Hampshire Fish and Game Department has observed eels upstream of the Bellows Falls and Wilder dams. More recently, eels have been observed in Lake Morey, Vermont, which is located upstream of Wilder Dam (Lael Will, VDFW, personal communication). Therefore, while it is clear that some eels are passing all three dams (Vernon, Bellows Falls, and Wilder), it remains unknown how many eels may be rearing in the mainstem habitat upstream of the dams or in tributaries and lakes and ponds that feed into the mainstem river.

No targeted eel surveys have been conducted to determine the abundance and distribution of American eels in riverine and lacustrine habitat upstream of the three projects. This information gap needs to be filled so resource agencies can evaluate properly the need for, and timing of, downstream passage and protection measures for outmigrating silver phase eels.

It should be noted that within the past seven years, the USFWS has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on

November 18, 2004. On July 6, 2005 the USFWS issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability. On September 29, 2011 the USFWS issued a substantial 90-day finding and initiated a 12-month status review. The USFWS is still accepting new American eel information for the ongoing status review. The USFWS also is currently in settlement negotiations with CESAR on their legal complaint that the USFWS failed to complete the 12-month finding within the statutory timeframe. It is likely that the USFWS's 12-month finding on the latest petition will be made prior to any new licenses being issued for the projects.

Project Nexus

The project configurations present problems with respect to providing safe, timely and effective passage for outmigrating eels. The intakes are deep and, while no specification for the trashracks were provided in the PADs, it is unlikely that they would prevent impingement and/or entrainment of eels. Existing anadromous downstream passage facilities at the projects also would not be expected to be effective for eels; the target anadromous species are surface-oriented, while eels tend to move much deeper in the water column. If eels are utilizing habitat upstream of the dams, then appropriate protection and downstream passage measures will be needed.

In order to understand the need for, and timing of, downstream eel passage at the projects, we are requesting that TransCanada undertake eel surveys in the Connecticut River upstream of the three dams and in tributaries feeding into the mainstem river within the project areas. Surveying tributary habitat is necessary because surveying the mainstem alone may lead to an underestimation of eel abundance, particularly if there are relatively short tributary streams that lead to a lake or pond (where eels may accumulate, leading to true high densities).

Proposed methodology

The Agency requests an eel survey be conducted in the mainstem river an tributaries upstream from the three projects. The methodology should be similar to that used in the relicensing of the Saluda Hydroelectric Project, FERC No. 516 (Appendix A), the eel assessment for the Merrimack River completed by the USFWS's Central New England Fishery Resources Office (Appendix B), and the proposed study plan for the relicensing of the Eastman Falls Project (FERC No. 2457)[3].

In general, a combination of electroshocking (backpack in wadeable rivers and boat-mounted in larger rivers and lakes) and eel pots should be used to collect eels and determine catch rates. Sampled habitat should include: the mainstem Connecticut River from upstream of Vernon Dam to below the Ryegate Dam; tributaries to the Connecticut within that stretch where eels have been collected previously; and lakes and ponds (such as, but not limited to, Spofford Lake and Lake Morey), where eels have been collected previously. Sampling should occur during the summer (July through September).

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[3] FERC Accession No. 20121214-5121

Level of Effort and Cost

The expected level of effort and anticipated costs will be comparable to that experienced on similar FERC projects of this size. A study plan recently submitted for the Eastman Falls Project (FERC No. 2457) on the Pemigewasset River in New Hampshire, which is utilizing a similar methodology, estimated that sampling a nine-mile-long impoundment with shocking and eel pots would cost $25,000. They estimated the effort to be two nights for the electrofishing survey. Given the much larger area that will need to be sampled under this request, we estimate moderate cost and effort will be required (20 days of shocking mainstem habitat plus another 5-10 days for tributaries and associated lake/pond habitat).

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Wilder Hydroelectric Project – FERC No. 1892-026
Bellows Falls Hydroelectric Project – FERC No. 1855-045
Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 16: Project effects on populations of tessellated darter, Etheostoma olmstedi

Goals and Objectives

The goal of this study is to evaluate the effects of project operations on populations of tessellated darter (*Etheostoma olmstedi*), a New Hampshire species of greatest conservation concern and known host species for the federally-endangered dwarf wedgemussel (*Alasmidonta heterodon*). The specific objectives of the study are to:

1. Determine the distribution and abundance of tessellated darter within project-affected areas; and
2. Determine the effects of project operations on the distribution and abundance of tessellated darter.

Resource Management Goals

The Agency's goals related to aquatic natural resources are to:

1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Vermont Fish and Wildlife Department's Strategic Plan (2002 -2010) focuses towards four major areas of concern: resource conservation, fish and wildlife-based recreation and use, human health and safety, efficient operations, and effective management.

The tessellated darter is one of only three fish species in the Upper Connecticut River that serve as hosts for the glochidia of the federally-endangered dwarf wedgemussel, the others being the slimy sculpin (*Cottus cognatus*) and the Atlantic salmon (*Salmo salar*) (Wicklow 2005).

Tessellated darters may be the most important hosts for the dwarf wedgemussel in the Upper Connecticut for the following reasons:

- The USFWS has decided to end its program of stocking hatchery-reared salmon in the Connecticut River basin and accordingly it is unlikely that salmon parr will be available as potential hosts.
- The tessellated darter appears to be more widespread than the slimy sculpin in the Bellow Falls and Wilder project areas where the dwarf wedgemussel is known to exist. Yoder et. al. (2009) found the darter in the project areas upstream and downstream of both dams, while the sculpin was not found in either project area.

The dwarf wedge mussel is state and federally listed as endangered. Populations in the Upper Connecticut River are dependent on healthy tessellated darter populations, and therefore a better understanding of how dam operations affect the darter is crucial to the recovery of the dwarf wedgemussel.

A mission of both the New Hampshire Fish and Game Department and the Vermont Fish and Wildlife Department is to protect and conserve fish and wildlife and their habitats. Riverine fish species are an important component of the river's ecology. Tessellated darter is identified by New Hampshire as a Species of Greatest Concern.

Public Interest Consideration
The requestor is a resource agency.

Existing Information
In the Preliminary Application Documents (PADs)s for the Wilder, Bellows Falls, and Vernon projects, the applicant acknowledges that tessellated darter is one of the confirmed hosts of dwarf wedgemussel. It also identifies the occurrence of tessellated darter both upstream and downstream of each project. However, studies that specifically target small-bodied benthic species are lacking in project-affected areas. It is therefore likely that results of previous investigations are biased and underestimate true population size. An effective evaluation of project effects on a population will require robust, unbiased estimates of population parameters such as abundance or occupancy and similar estimates of population parameters under known conditions of low to no effect.

Existing literature indicates that tessellated darters may be found in a variety of habitats (Scott and Crossman 1979, Van Snik Gray and Stauffer 1999, Hartel 2002, Van Snik Gray et al. 2005, Henry and Grossman 2008), but these habitats are not necessarily equal in their ability to support the population or its function as host to dwarf wedgemussel. We cannot be certain that habitat use infers preference, nor that habitat use will be consistent from basin to basin. Therefore, habitat use within project-affected areas should be evaluated, and should be evaluated in concert with population parameters. By estimating population parameters (e.g., abundance, occupancy, extinction/colonization) as functions of habitat, we may determine whether habitat contributes to any differences in populations and if so, what specific habitat is preferred for stable and persistent populations.

Project Nexus
Operations at the Wilder, Bellows Falls, and Vernon projects alter natural river flow and consequently cause changes in the availability of instream habitat on which the tessellated darter and other lotic species depend. Habitat for tessellated darters is directly related to project operations in terms of flow (water depth and velocity, and their timing, duration, frequency, and rate of change) as well as the interactions of flow with other habitat variables such as substrata, vegetation, and cover. Operations both upstream (changes to the reservoir) and downstream (changes to the flow regime) may affect habitat, and may consequently lead to changes in the distribution, abundance, and behavior of tessellated darters that could in turn potentially affect the federally-endangered dwarf wedge mussel, for which the tessellated darter is a host species.

The information collected for this requested study will help determine whether project operations have a substantial effect on populations of tessellated darter, or whether population parameters are consistent with those of other populations in the region. If there is an effect of project operations on darter populations, study results will also permit identification of those habitat components related to operations that are most important for maintenance of stable and persistent populations of tessellated darter. This will in turn provide information that will assist the development of recommendations aimed to maintain populations of dwarf wedgemussel.

Proposed Methodology
Using an accepted and robust field sampling design (e.g., as described in Pollock et al. 2002 or MacKenzie et al. 2006) and accepted methods for collecting tessellated darters and other similar small-bodied fishes, conduct a field survey for tessellated darters within all project-affected areas from the headwaters of the Wilder pool downstream to the Vernon dam, as well as in selected areas outside of the project-affected areas with known stable populations of tessellated darter and/or dwarf wedgemussel. Such a sampling design should include replicate samples for estimation of species detection probability. For each replicate sample, collect and record data that may be important for describing differences in populations of tessellated darter, such as presence or abundance of other species (e.g., dwarf wedgemussel, slimy sculpin *Cottus cognatus*), depth, velocity, water temperature, substrata, time of day, presence of cover, proportion of vegetation cover, size of individuals collected (juveniles may select different habitat; larger individuals may outcompete smaller individuals for preferred habitat), and other factors as determined by a qualified biologist. Include also as covariates any relevant flow characteristics (Zimmerman 2006) that may differ among sites.

Using methods as described by Kery et al. (2005), MacKenzie et al. (2006), or Wenger and Freeman (2008), determine whether population estimates of tessellated darter are different in project-affected areas and, if so, which measured factors or flow characteristics are most important in describing these differences.

Level of Effort and Cost
The cost for collecting the data for this study is entirely dependent on the number of sites, number of sample replicates, and the extent of the covariate data that are measured, all of which and should be determined during the development of the study plan in consultation with fishery agencies and other parties, and may be adjusted during the course of field sampling. In general, if a species is common and easily captured, few replicates and many sites produce the best

estimates, whereas more replicates and fewer sites are preferable for rare species. In general, the more replicates added, the lower the errors in detection probability, and the more sites sampled, the lower the errors in population parameters. The number of people required in the field will be dependent on the sampling method that is selected, but should be at least two individuals. Provided the collected data are of high quality, analysis and synthesis should take at most 5-10 days.

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Wilder Hydroelectric Project – FERC No. 1892-026
Bellows Falls Hydroelectric Project – FERC No. 1855-045
Vernon Hydroelectric Project – FERC No. 1904-073

*Study Request 17: Assessment of adult sea lamprey (***Petromyzon marinus***) spawning within the project areas*

Goals and Objectives

The goal of this project is to assess the level of spawning activity by sea lamprey in the Wilder, Bellows Falls, and Vernon project areas and determine whether operations at these projects are affecting the success (i.e., survival to emergence) of lamprey spawning.

The objectives are:

Identify areas within the Wilder, Bellows Falls, and Vernon project areas where suitable spawning habitat exists for sea lamprey.

Conduct a telemetry study of sea lamprey during their upstream migration period in the spring, focusing on areas of suitable spawning habitat, and areas of known spawning.

Conduct spawning ground surveys to observe the utilization of this habitat for spawning purposes, and hence, confirm suitability.

Obtain data on redd characteristics including location, size, substrate, depth and velocity.

Determine if the operations at the Wilder, Bellows Falls and Vernon projects are adversely affecting these spawning areas (i.e. if flow alterations are causing dewatering and/or scouring of sea lamprey redds). If it is determined that the operations of the projects are adversely affecting the spawning success of sea lamprey, identify operational regimes that will reduce and minimize impacts to sea lamprey spawning habitat and spawning success within the project area.

Resource Management Goals

The Agency's goals related to aquatic natural resources are to:

1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the

VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Vermont Fish and Wildlife Department's Strategic Plan (2002 -2010) focuses towards four major areas of concern: resource conservation, fish and wildlife-based recreation and use, human health and safety, efficient operations, and effective management.

The sea lamprey (*Petromyzon marinus*), within the Connecticut River drainage, is one of New Hampshire and Vermont's Species of Greatest Conservation Need (SGCN). The conservation status of sea lamprey in New Hampshire is listed as "vulnerable." One of the threats identified in Vermont's Wildlife Action Plan (Kart et al. 2005) is degraded spawning habitat, which is second to habitat fragmentation.

As outlined in Vermont's Wildlife Action Plan (Kart et al. 2005), research and monitoring needs for SGCN include monitoring and assessing populations and habitats for current conditions and future changes, and identifying and monitoring problems for species and their habitats.

One of the conservation strategies identified in the Vermont Wildlife Action Plan, is protecting and restoring aquatic and riparian habitats through improved water quality; flow, water level and temperature regimes; sediment reduction; establishment of streamside buffers; and suitable aquatic habitat structure, diversity and complexity.

In support of conservation strategies and research needs listed above, identifying potential impacts that the Wilder, Bellows Falls, and Vernon Projects have on sea lamprey spawning is paramount. Results of the study will be used to develop flow-related license requirements and/or other mitigation measures that will optimize spawning habitat for a New Hampshire and Vermont SGCN.

Public Interest Consideration
The requestor is a state resource agency.

Existing Information
It is known that sea lamprey spawn in the Connecticut River main stem at least as far upstream as Wilder Dam, as well as tributary waters including the West, Williams, Black and White Rivers (Kart et al. 2005).

The PAD discusses sea lamprey distribution as: "FWS (2012) lists the current upstream extent of sea lamprey range as Bellows Falls Dam, noting, however, that reproduction has been documented as far north as the White River, Vermont, in the Wilder Project area. In certain years hundreds to thousands of sea lamprey have been recorded passing upstream of Bellow Falls dam, and in at least one year (2008) sea lamprey were documented passing upstream via the Wilder Dam fish ladder. In 2008 surveys, Yoder et al. (2009) documented sea lamprey just downstream of the confluence of the White River."

In 2012 at total of 99 sea lamprey were observed passing the Bellows Falls Dam, and a total of 696 sea lamprey were observed passing the Vernon Dam.

To date no studies have been conducted that aim to identify spawning habitat and spawning activity of sea lamprey within in the Wilder, Bellows Falls, and Vernon project areas and whether Project operations are affecting these activities.

Project Nexus

The operation of the Wilder, Bellows Falls and Vernon projects including minimum flows and large and rapid changes in flow releases from the dam have the potential to cause direct adverse effects on spawning habitat and spawning activity downstream of the dam. If adult sea lampreys are actively spawning in the project area, it is important to assess whether operations of the projects are having any adverse effects (i.e. dewatering and scouring) on these activities.

Proposed Methodology

Although a relatively new practice, the tagging and tracking of adult Pacific lamprey to determine final destination, has been successfully conducted in the Columbia River (Noyes et al. 2012). Similarly, from 2005-2009, radio telemetry was used to determine adult lamprey overwintering and spawning habitats, and spawn timing in the lower Deschutes River Subbasin (Fox et al. 2009).

In Vermont, factors affecting sea lamprey survival were examined (Smith and Marsden 2009). It was found that predation, water currents, and displacement of eggs from the nest, played a role in survival.

As part of the Wells Hydroelectric project (FERC No. 2149), Pacific lamprey spawning ground surveys were conducted to determine project effects on spawning success.

In 2010, redd surveys were completed in Shitike and Beaver Creeks to identify recent redds for placement of an experimental redd cap. The purpose of capping lamprey redds was to enumerate emerging larvae and to document timing of emergence with respect to estimated date of redd construction and water temperature (Fox et al. 2010). Therefore, to determine project effects on the spawning success of sea lamprey methods should follow Fox et al. (2010).

Level of Effort and Cost

The estimated level of effort and costs for this recommended study is expected to be moderate to high. The applicant did not propose any alternative studies in its PAD to address this specific issue.

Literature Cited

Fox, M. J.C. Graham, and S. Frank. 2009. Determining Adult Pacific Lamprey Abundance and Spawning Habitat in the Lower Dechutes River Sub-Basin, Oregon. Department of Natural Resources Confederated Tribes of the Warm Springs Reservation, Oregon

Fox, M. J.C. Graham, and S. Frank. 2010. Determining Adult Pacific Lamprey Abundance and Spawning Habitat in the Lower Dechutes River Sub-Basin, Oregon. Department of Natural Resources Confederated Tribes of the Warm Springs Reservation, Oregon

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department. Waterbury, Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm. (Accessed September 10, 2012).

Le, Bao and S. Kreiter. 2008. An assessment of Adult Pacific Lamprey Spawning within the Wells Project. Wells Hydroelectric Project NO. 2149.

Noyes, C.J., C.C. Caudill, T.S. Clabough, D.C. Joosten, E.L. Johnson, M.L. Keefer, and G.P. Naughton. 2011. Adult Pacific lamprey migration behavior and escapement in the Bonneville Reservoir and Lower Columbia River monitored using the juvenile salmonid acoustic telemetry system (JSATS). Technical Report 2012-4-Draft

Smith, S. J. and J. E. Marsden. 2009. Factors Affecting Sea Lamprey Egg Survival. North American Journal of Fisheries Management 29:859–868.

Vermont Fish and Wildlife Department . 2006. Vermont Fish and Wildlife Strategic Plan. http://www.vtfishandwildlife.com/library/reports_and_documents/Fish_and_wildlife/Strategic_Plan.pdf

Wilder Hydroelectric Project – FERC No. 1892-026
Bellows Falls Hydroelectric Project – FERC No. 1855-045
Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 18: Impacts of impoundment water level fluctuations on resident fish spawning

Goals and Objectives

The goal of this study is to determine if the full range of water level fluctuations in the Vernon, Bellows Falls and Wilder Hydroelectric Projects negatively impact resident fish species (smallmouth bass, largemouth bass, yellow perch, black crappie, common sunfish, bluegill, chain pickerel, northern pike, golden shiner, common white sucker, spottail shiner, walleye and fallfish) in the impoundments, and if impacts are found to occur, to develop appropriate mitigation measures.

Specific objectives include:
1) Conduct field studies in the mainstem, tributaries and backwaters of project affected areas to assess timing and location of fish spawning. Nesting locations should be mapped.

2) Conduct field studies in the mainstem, tributaries and backwaters of project-affected areas to evaluate potential impacts of impoundment fluctuation on spawning habitat, nest abandonment, spawning fish displacement and egg dewatering. The study should also evaluate if changes in impoundment fluctuation range would mitigate for identified impacts and if other mitigative measures would lessen these impacts.

Resource Management Goals

The Agency's goals related to aquatic natural resources are to:

1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

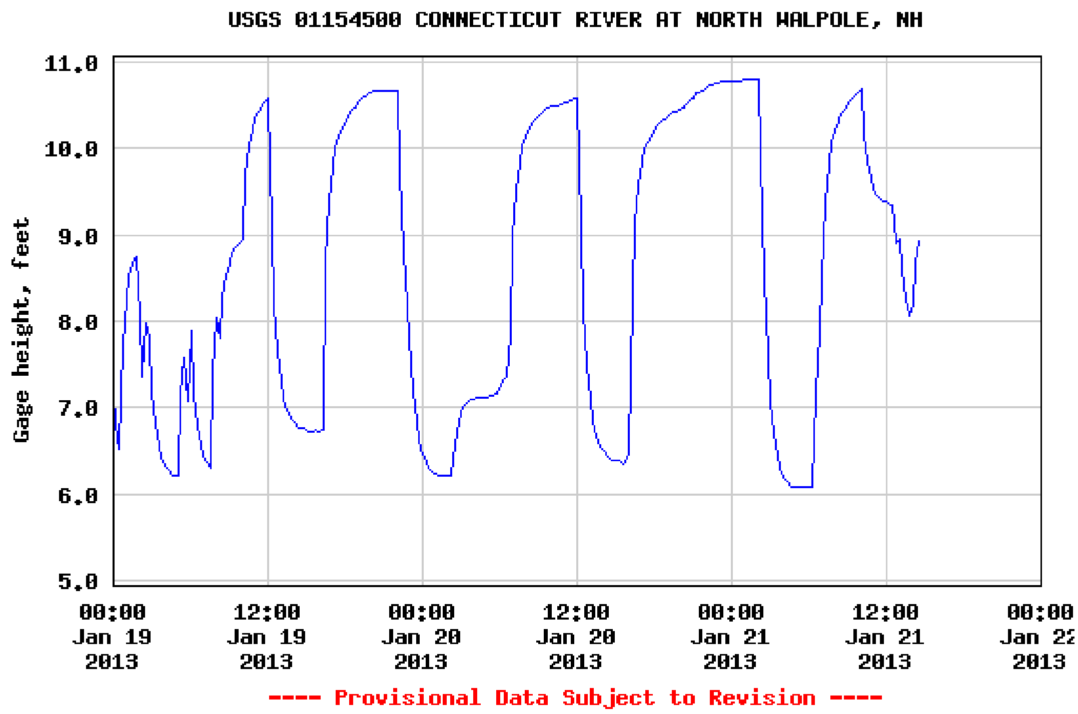
Vermont Fish and Wildlife Department's Strategic Plan (2002 -2010) focuses towards four major areas of concern: resource conservation, fish and wildlife-based recreation and use, human health and safety, efficient operations, and effective management.

Riverine fish species are an important component of the river's ecology and in some cases are the basis for a sport fishery. This requested study will help protect and conserve resident fish species by ensuring project operations do not negatively impact their spawning success.

Public Interest Consideration
The New Hampshire Fish and Game Department, the Vermont Fish and Wildlife Department, and the New Hampshire Department of Environmental Services are requesting this study. The requestors are state natural resource agencies.

Existing Information
To our knowledge, no information exists related to this requested study.

An example of the water level fluctuations that occur in the Lower Connecticut River due to hydropower generation is shown below.



Project Nexus
Project operations have the potential to impact fish species by influencing spawning success and spawning habitat quality and quantity. For example, water level changes due to project operations could create conditions where fish eggs are exposed to air, where quality spawning

habitat is dewatered, and/or where fish abandon nests containing eggs. The New Hampshire Fish and Game Department has received several calls in past springs regarding "acres" of yellow perch eggs being dewatered in the Bellows Falls Impoundment.

The projects operate within normal, permitted and flood-condition reservoir fluctuation limits that include during high flow events, the dropping of stanchion bays that cannot be raised without a subsequent drawdown of the impoundment beyond normal project operating ranges. The full range of reservoir fluctuations, including periodic drawdowns for stanchion bay replacement, need to be addressed in this study.

Proposed Methodology

Common tools to evaluate fish spawning and habitat would be used including, but not limited, electrofishing, visual observations, telemetry and habitat measurements. The study area for this request includes all impounded waters, including tributaries and backwaters, within the project-affected areas of the Vernon, Bellows Falls and Wilder Hydroelectric Projects. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

Level of Effort and Cost

TransCanada does not propose any studies to meet this need. Estimated cost for the study is moderate to high but is dependent on the amount of field study that is needed.

Literature Cited

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department. Waterbury, Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm. (Access September 10, 2012).

Vermont Fish and Wildlife Department . 2006. Vermont Fish and Wildlife Strategic Plan. http://www.vtfishandwildlife.com/library/reports_and_documents/Fish_and_wildlife/Strategic_Plan.pdf

Turners Falls Hydroelectric Project – FERC No. 1889-081
Northfield Mountain Pumped Storage Project – FERC No. 2485-063

Study Request 18: Impacts of impoundment water level fluctuations on resident fish spawning

Goals and Objectives

The goal of this study is to determine if project operations and water level fluctuations in the Turners Falls Project impoundment negatively impact anadromous and resident fish species including but not limited, to sea lamprey, white sucker, fall fish, smallmouth bass, yellow perch, spottail shiners, bluegill, black crappie, chain pickerel, northern pike, common sunfish, and walleye, and if impacts are found to occur, to develop appropriate mitigation measures. This study complements a separate study requests specific to American shad spawning and also on habitats affected by water level manipulations. An additional instream flow study request will address fish habitat effects for species of concern downstream of the Turners Falls Dam.

Specific objectives include:

1. Conduct field studies in the main stem, tributaries and backwaters of project affected areas to assess timing and location of fish spawning.
2. Conduct field studies in the main stem, tributaries and backwaters of project affected areas to evaluate potential impacts of impoundment fluctuation on nest abandonment, spawning fish displacement and egg dewatering. The study should also evaluate if changes in impoundment fluctuation range would mitigate for identified impacts and if other mitigative measures would lessen these impacts.

A second year of study may be required should river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period (end of March through mid July). Similarly, water temperatures should be closely considered, to ensure representative conditions occurred to reduce bias in observations.

Resource Management Goals

The Agency's goals related to aquatic natural resources are to:

1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Vermont Fish and Wildlife Department's Strategic Plan (2002 -2010) focuses towards four major areas of concern: resource conservation, fish and wildlife-based recreation and use, human health and safety, efficient operations, and effective management.

Riverine fish species are an important component of the river's ecology and in some cases are the basis for a sport fishery. This requested study will help protect and conserve resident fish species by ensuring Project operations do not negatively impact their spawning success and spawning habitats.

Public Interest Consideration

The requestor is a resource agency.

Existing Information

To our knowledge, no information exists related to this requested study. The Massachusetts Integrated List of Waters shows the Project Area from the VT/NH state line to the Turners Falls Dam impaired due to "other flow regime alterations."

Project Nexus

Project operations have the potential to impact fish species by influencing spawning success and spawning habitat quality and quantity. For example, water level changes due to Project operations could create conditions where fish eggs are exposed to air, where spawning habitat is dewatered, and/or where fish abandon nests containing eggs.

Proposed Methodology

Common tools to evaluate fish spawning would be used including visual observations of habitats and sampled fish (i.e., in spawning condition, coloration, gonads mature, and other external features that become developed with spawning) collected by gears such as electrofishing, seining and other net gears during defined environmental and or time windows for spawning activity. Project operation impacted areas, should be quantified to identify and define areas subject to dewatering and mapped relative to observations of fish nests, spawning fish, egg deposits. During identified spawning periods for these species, suitable spawning habitats subjected to daily project operational fluctuations will be surveyed to document the type and extent of project effects on nests or spawning habitat (fall fish nests, lamprey nests, bass and sunfish nests, white sucker eggs/larvae) and observable eggs or larvae, relative to water level and other environmental condition, including water temperature and water velocity in noted areas.

Level of Effort and Cost

FirstLight Power does not propose any studies to meet this need. Estimated cost for the study is moderate.

Literature Cited

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department. Waterbury, Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm. (Access September 10, 2012).

Vermont Fish and Wildlife Department . 2006. Vermont Fish and Wildlife Strategic Plan. http://www.vtfishandwildlife.com/library/reports_and_documents/Fish_and_wildlife/Strategic_Plan.pdf

Wilder Hydroelectric Project – FERC No. 1892-026
Bellows Falls Hydroelectric Project – FERC No. 1855-045
Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 19: Impacts of project operations on tributary and backwater area access and habitats.

Goals and Objectives
One goal of this study is to determine if water level fluctuations from the Vernon, Bellows Falls and Wilder Hydroelectric Projects result in a barrier(s) to fish movement in and out of tributaries and backwaters to the impoundments and riverine reaches below dams.

A second goal is to determine if water level fluctuations in the Vernon, Bellows Falls and Wilder Project impoundments impact water levels, available fish habitat and water quality in tributaries and backwaters to the impoundments and riverine reaches below dams, and if impacts are found, to ascertain how spatially far reaching they are and develop mitigation measures.

Results of this study may also be used to help determine the adequacy of existing downstream minimum flow requirements.

Specific objectives include:
1) Conduct a field study of tributaries and backwaters, including water velocity and habitat data where appropriate, to evaluate potential impacts of impoundment fluctuation on fish access to tributaries and backwater areas. The study should also evaluate if changes in impoundment fluctuation range would mitigate for any identified impacts and if other mitigative measures would improve access.

2) Conduct a field study to examine potential impacts of impoundment fluctuations on water levels, available habitat and water quality in tributaries and backwaters. The evaluation should also evaluate if changes in impoundment fluctuation range would mitigate for identified impacts and if other mitigative measures would lessen these impacts.

Resource Management Goals
The Agency's goals related to aquatic natural resources are to:

1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the

VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Vermont Fish and Wildlife Department's Strategic Plan (2002 -2010) focuses towards four major areas of concern: resource conservation, fish and wildlife-based recreation and use, human health and safety, efficient operations, and effective management.

Diadromous and resident riverine fish species are an important component of the river's ecology and in some cases are the basis for a sport fishery. Furthermore, two of the states' Species of Greatest Conservation Need (SGCN) that would potentially be impacted have been documented in the project-affected areas.

This requested study will help promote tributary and backwater access and protect valuable fish habitat and maintain appropriate water quality conditions for diadromous and riverine fish species in project-affected areas. Maintaining connectivity between the mainstem of the Connecticut River and tributaries and backwaters is vital to the fish populations in these systems, as many fish species utilize these areas for spawning, rearing, refuge, and feeding.

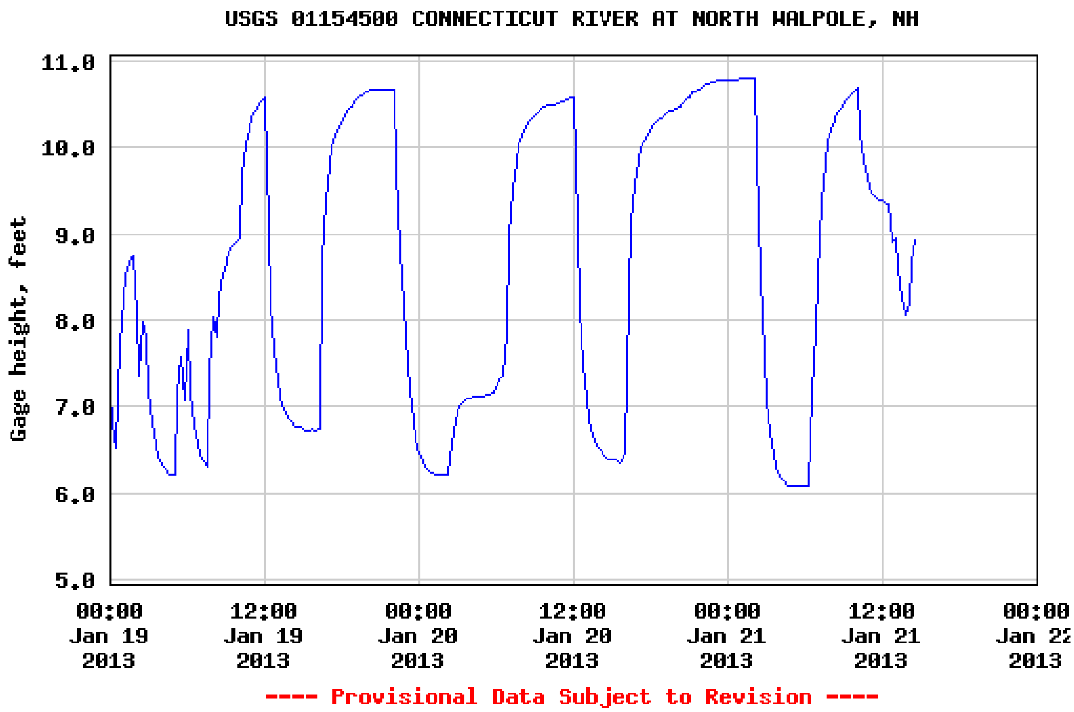
Public Interest Consideration

The New Hampshire Fish and Game Department, the Vermont Fish and Wildlife Department, and the New Hampshire Department of Environmental Services are requesting this study. The requestors are state natural resource agency.

Existing Information

To our knowledge, no information exists related to this requested study.

An example of the water level fluctuations that occur in the Lower Connecticut River due to hydropower generation is shown below.



Project Nexus

Project operations have the potential to impact fish species life history requirements, biological interactions, and habitat quantity and quality. For example, water level changes due to project operations could create conditions that could impede free movement of fish between tributaries/backwaters and the mainstem of the Connecticut River, thus limiting access to spawning habitat and/or growth opportunities. Additionally, water level changes could also alter tributary and backwater fish habitat quality, quantity, and also water quality, thus decreasing productivity and available habitat. Furthermore, two of New Hampshire and Vermont's SGCN that could be impacted have been documented in the project-affected areas.

Proposed Methodology

Common tools to evaluate water level impacts would be used including: bathymetric mapping, substrate, depth and velocity measurements, and water quality information (dissolved oxygen, temperature, turbidity, and pH). Studies should be conducted throughout the year.

The study area for tributary and backwater fish sampling should cover all tributaries and backwaters within the project-affected areas of the Vernon, Bellows Falls and Wilder Hydroelectric Projects. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

Level of Effort and Cost

TransCanada does not propose any studies to meet this need. Estimated cost for the study is relatively low.

Literature Cited

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department. Waterbury, Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm. (Access September 10, 2012).

Vermont Fish and Wildlife Department . 2006. Vermont Fish and Wildlife Strategic Plan. http://www.vtfishandwildlife.com/library/reports_and_documents/Fish_and_wildlife/Strategic_Plan.pdf

Turners Falls Hydroelectric Project – FERC No. 1889-081
Northfield Mountain Pumped Storage Project – FERC No. 2485-063

Study Request 19: Impacts of project operations on tributary and backwater area access and habitats.

Goals and Objectives

One goal of this study is to determine if water level fluctuations from the Turners Falls and Northfield Mountain Pumped Storage projects result in a barrier(s) to fish movement in and out of tributaries and backwaters to the impoundments and riverine reaches below dams.

A second goal is to determine if water level fluctuations in the Turners Falls and Northfield Mountain Pumped Storage project impoundments impact water levels, available fish habitat and water quality in tributaries and backwaters to the impoundments and riverine reaches below dams, and if impacts are found, to ascertain how spatially far reaching they are and develop mitigation measures.

Results of this study may also be used to help determine the adequacy of existing downstream minimum flow requirements.

Specific objectives include:
1) Conduct a field study of tributaries and backwaters, including water velocity and habitat data where appropriate, to evaluate potential impacts of impoundment fluctuation on fish access to tributaries and backwater areas. The study should also evaluate if changes in impoundment fluctuation range would mitigate for any identified impacts and if other mitigative measures would improve access.

2) Conduct a field study to examine potential impacts of impoundment fluctuations on water levels, available habitat and water quality in tributaries and backwaters. The evaluation should also evaluate if changes in impoundment fluctuation range would mitigate for identified impacts and if other mitigative measures would lessen these impacts.

Resource Management Goals

The Agency's goals related to aquatic natural resources are to:
1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the

VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Vermont Fish and Wildlife Department's Strategic Plan (2002 -2010) focuses towards four major areas of concern: resource conservation, fish and wildlife-based recreation and use, human health and safety, efficient operations, and effective management.

This requested study will help promote tributary and backwater access and protect valuable fish habitat and maintain appropriate water quality conditions for diadromous and riverine fish species in project-affected areas. Maintaining connectivity between the mainstem of the Connecticut River and tributaries and backwaters is vital to the fish populations in these systems, as many fish species utilize these areas for spawning, rearing, refuge, and feeding.

Public Interest Consideration

The requestor is a state natural resource agency.

Existing Information

To our knowledge, limited information exists related to this requested study.

Project Nexus

Project operations have the potential to impact fish species life history requirements, biological interactions, and habitat quantity and quality. For example, water level changes due to project operations could create conditions that could impede free movement of fish between tributaries/backwaters and the mainstem of the Connecticut River, thus limiting access to spawning habitat and/or growth opportunities. Additionally, water level changes could also alter tributary and backwater fish habitat quality, quantity, and also water quality, thus decreasing productivity and available habitat.

Proposed Methodology

Common tools to evaluate water level impacts would be used including: bathymetric mapping, substrate, depth and velocity measurements, and water quality information (dissolved oxygen, temperature, turbidity, and pH). Studies should be conducted throughout the year.

The study area for tributary and backwater fish sampling should cover all tributaries and backwaters within the project-affected areas of the Turners Falls and Northfield Mountain Pumped Storage projects. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

Level of Effort and Cost
First Light does not propose any studies to meet this need. Estimated cost for the study is moderate.

Literature Cited

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department. Waterbury, Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm. (Access September 10, 2012).

Vermont Fish and Wildlife Department . 2006. Vermont Fish and Wildlife Strategic Plan. http://www.vtfishandwildlife.com/library/reports_and_documents/Fish_and_wildlife/Strategic_Plan.pdf

Wilder Hydroelectric Project – FERC No. 1892-026
Bellows Falls Hydroelectric Project – FERC No. 1855-045
Vernon Hydroelectric Project – FERC No. 1904-073
Turners Falls Hydroelectric Project – FERC No. 1889-081
Northfield Mountain Pumped Storage Project – FERC No. 2485-063

Study Request 20: Evaluation of timing of downstream migratory movements of American eels on the mainstem Connecticut River

Goals and Objectives

The goal of this study is to better understand migration timing of adult, silver-phase American eels as it relates to environmental factors and operations of mainstem hydropower projects on the Connecticut River.

The objective of this study is to quantify and characterize the general migratory timing and presence of adult, silver-phase American eels in the Connecticut River relative to environmental factors and operations of mainstem river hydroelectric projects

Resource Management Goals

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Vermont Fish and Wildlife Department's Strategic Plan (2002 -2010) focuses towards four major areas of concern: resource conservation, fish and wildlife-based recreation and use, human health and safety, efficient operations, and effective management.

The Agency's goals related to aquatic natural resources are to:

1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The American eel (*Anguilla rostrata*), is listed as one of both New Hampshire's and Vermont's Species of Greatest Conservation Need (SGCN). The status for conservation need in Vermont is listed as high priority (Kart et al. 2005), and the species is listed as "vulnerable" in New Hampshire. As identified in Vermont's Wildlife Action Plan (Kart et al. 2005), threats to the species include the construction of large dams on rivers which obstruct juvenile fish access to critical rearing habitats, as well as mortality associated with passing through hydroelectric facilities' turbines during their outmigration to sea.

As outlined in Vermont's Wildlife Action Plan (Kart et al. 2005), research and monitoring needs for this SGCN include determining their distribution and abundance, as the contribution of eels in northern regions to overall stock is unknown. One of the conservation strategies for this species is to support efforts to enhance access of American eels to Vermont waters by eliminating or minimizing impacts of dams and other obstructions along the Richelieu, St. Lawrence, and Connecticut Rivers.

The Atlantic States Marine Fisheries Commission has developed two documents related to the management of American eel:

1. Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.
2. Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

Objectives of the management plan include: (1) protect and enhance American eel abundance in all watershed where eel now occur; and (2) where practical, restore American eel to those waters where they had historical abundance but may now be absent by providing access to inland waters for glass eel, elvers, and yellow eel and adequate escapement to the ocean for pre-spawning adult eel.

Addendum II contains specific recommendations for improving upstream and downstream passage of American eel, including requesting that member states and jurisdictions seek special consideration for American eel in the FERC relicensing process.

The Connecticut River Atlantic Salmon Commission (CRASC) was established by Congress in 1983 (and reauthorized in 2002 for another 20 years) through the Connecticut River Atlantic Salmon Compact (Public Law 98-138). The Vermont Fish and Wildlife Department is a CRASC member agency, and a senior biologist from the department serves on the Technical Committee. In addition, the CRASC developed A Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin in 2005. The goal of the plan is "to protect and enhance the abundance of the American eel resource to ensure its continued role in the Connecticut River Basin ecosystem…" Management objectives in the plan include the following:

1. Protect and enhance eel populations where they currently exist;
2. Where practical, restore populations to waters where they had historical abundance;
3. Provide effective upstream and downstream fish passage around dams and other barriers within the species' range in the basin; and
4. Comply with all requirements of the Fishery Management Plan of the ASMFC.

Based on these plans, the Agency seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to downstream passage of American eel, the Agency goals are:

1. Minimize current and potential negative project operation effects that could hinder management goals and objectives.
2. Minimize project-related sources of downstream passage delay, injury, stress, and mortality in order to maximize the number of silver eels migrating to the spawning grounds.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq*.), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq*.), and the Federal Power Act (16 U.S.C. §791a, *et seq*.).

Public Interest Consideration

The requester is a state resource agency.

Existing Information

Data on timing of downstream migratory movements and rates of American eels in the mainstem Connecticut River are sparse and relatively incomplete. Preliminary data on presence of "eel-sized" acoustic targets have been collected (Haro et al. 1998) within the Turners Falls Project's Cabot Station forebay that were somewhat confirmed by video monitoring at the Cabot Station downstream fish bypass; however, these were short-term studies, with acoustic monitoring only performed from 17 September to 5 October and video monitoring only conducted between 18 September to 22 October.

Some daily monitoring of the downstream bypass at the Holyoke Dam (canal louver array) was performed in 2004 and 2005 (Kleinschmidt, Inc. 2005, 2006, Normandeau Associates 2007); these studies also were of relatively short duration (spanning from October 5 to November 10 in 2004 and September 9 to November 11 in 2005) and the sampler was only operated at night.

To date, no other directed studies of eel migratory movements have been conducted at any location on the Connecticut River mainstem. This information gap needs to be filled, as it relates directly to when downstream passage and protection measures need to be operated.

We also note that within the past seven years, the United States Fish and Wildlife Service (USFWS) has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005 the USFWS issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability. On September 29, 2011 the USFWS issued a substantial 90-day finding and initiated a 12-month status review. The USFWS is still accepting new American eel information for the ongoing status review. The USFWS also is currently in settlement negotiations with CESAR on their legal complaint that the USFWS failed to complete the 12-month finding within the statutory timeframe. Although the date for completion of the USFWS's 12-month finding on the latest petition is uncertain, it is likely that it will be made before any new licenses are issued for the projects.

Project Nexus

The timing of downstream migration of adult eels is poorly defined for the Connecticut River; therefore the general effects of hydroelectric project operations on eel survival to the ocean are unknown. Although separate study requests have been submitted to address project-specific downstream passage route selection, delays, and mortality of eels, general characteristics of river flow and environmental conditions may have significant relationships with project operation and eel migratory success and survival. For example, eels may tend to move immediately before or during periods of significant precipitation (or consequently river flow); times at which projects may be generating at maximum capacity or spilling, which may (or may not) present a higher passage risk to eels. Conversely, periods of low flow may be associated with a significant proportion of total river flow passing through turbine units, which present additional (or different) passage risk to eels. If discrete conditions which promote eel downstream migration are known, it may be possible to take actions with respect to project operations which reduce or minimize passage risk; i.e., operation of a bypass, reduction of intake approach velocities, directed spillage through a "safe" route, etc. These studies should provide baseline information on river-specific downstream migration to predict when silver-phase eels are expected to be migrating in the mainstem Connecticut River, from which project operations could be modified to minimize passage risks.

The studies are proposed for a single or multiple sites; the results will be relevant to all sites on the Connecticut River mainstem.

Proposed Methodology

Quantification of downstream movements of American eels in river systems requires systematic sampling of migrants throughout the migratory season. This can be accomplished with traditional active trapping methods; i.e., fyke or stow net sampling, weirs, or eel racks, but these methods are technically challenging on larger mainstem rivers, due to the scale of flows that need to be sampled, difficulties in operation throughout all flow conditions, and high debris loading during fall flows. Passive monitoring of migrant eels using hydroacoustic methods offers an alternative to active trapping. However, passive monitoring requires verification of potential acoustic targets with some level of active (collection) or visual (traditional optical or acoustic video) sampling.

Two potential locations offer opportunities to conduct simultaneous passive and active sampling: the Cabot Station (Turners Falls project) canal/forebay and the Holyoke Dam forebay and canal louver/bypass system. Each location possesses a route of downstream passage which conducts a significant proportion of river flow (Cabot canal and Holyoke forebay or canal), and each has a proximal bypass equipped with a sampler so that fish can be concentrated/collected from the passage route and identified to species. Project operations do influence the relative proportion of flow (and thus numbers of downstream migrant eels) in each passage route, so numbers of eels sampled in each route represent only a proportion of the total number of eels migrating downstream within the entire river. Because the absolute proportion of eels using a specific route at any one time is unknown, numbers of eels quantified within a route must serve as a relative index of the degree of migratory movement.

This study shall quantify eel movements in either one, or preferably both, locations for two consecutive years (since environmental conditions strongly influence migratory timing of eels, which can vary significantly from year to year; Haro 2003). Eels will be quantified using methods similar to Haro et al. (1999), by continuously monitoring a fixed location at the projects with hydroacoustics. Because eels tend to concentrate in areas of dominant flow (Brown et al. 2009, EPRI 2001), the zone to be monitored should pass a dominant proportion of project flow throughout most periods of operation (i.e., forebay intake area). Hydroacoustic monitoring shall encompass the entire potential migratory season, beginning in mid-August and ending in mid-December, and shall operate 24 hours per day. Data will be recorded for later processing and archiving.

Systematic active quantification of eels at downstream bypass samplers shall be performed simultaneously with passive hydroacoustic monitoring, to verify presence of eels and relative abundance of eel-sized hydroacoustic targets from the hydroacoustic data. Although daily operation of the bypass sampler could be performed, a more comprehensive technique is to monitor eels entering the bypass with an acoustic camera (i.e. DIDSON, BlueView, etc.). The acoustic camera will afford positive visual identification of eels as they enter the bypass, which is a concentration point for migrating eels. Acoustic camera monitoring will also allow monitoring to be performed 24 hours a day, and will be relatively unaffected by water turbidity (which influences effectiveness of traditional optical video monitoring). The acoustic camera system will be operated during the same time period as acoustic monitoring, and images will be recorded for later processing and archiving.

Data analyses of hydroacoustic, acoustic camera, bypass sampling, and environmental/ operational data will follow standard methodology.

Project operation (flows, levels, gate openings, number of units operating and operation level) and environmental conditions (river flow, temperature, turbidity, air temperature, precipitation) will be monitored regularly (hourly measurements if possible) throughout the duration of the studies.

These methodologies are consistent with accepted practice.

Level of Effort and Cost

The level of cost and effort for the downstream migrant eel migratory timing study would be moderate, given the level of cost for instrumentation, deployment, and data review/analysis. Cost is estimated at $50,000 per year for the study.

The applicant did not propose any studies to meet this need in the PAD.

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Brown, L.S. 2005. Characterizing the downstream passage behavior of silver phase American eels at a small hydroelectric facility. M.Sc. Thesis, Department of Natural Resource Conservation, University of Massachusetts, Amherst, Massachusetts. 110 pp.

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Wilder Hydroelectric Project – FERC No. 1892-026
Bellows Falls Hydroelectric Project – FERC No. 1855-045
Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 21: Downstream American eel passage

Goals and Objectives

The goal of this study is to determine the impact of three hydroelectric projects on the outmigration of silver eels in the Connecticut River. Entrainment at the conventional turbines at the Vernon, Bellows Falls, and Wilder projects can result in mortality or injury. It is important to understand the passage routes at each project and the potential for delay, injury, and mortality to assess alternative management options to increase survival.

The objectives of this study are:

1. Quantify the movement rates (including delays) and relative proportion of eels passing via various routes at the projects (i.e. through the turbines, through the downstream bypasses; spilled at the dams, etc.).
2. Evaluate instantaneous and latent mortality and injury of eels passed via each potential route.

Resource Management Goals

The Agency's goals related to aquatic natural resources are to:

1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Vermont Fish and Wildlife Department's Strategic Plan (2002 -2010) focuses towards four major areas of concern: resource conservation, fish and wildlife-based recreation and use, human health and safety, efficient operations, and effective management.

The American eel (*Anguilla rostrata*), is listed as one of both New Hampshire's and Vermont's Species of Greatest Conservation Need (SGCN). The status for conservation need in Vermont is listed as high priority (Kart et al. 2005), and the species is listed as "vulnerable" in New Hampshire. As identified in Vermont's Wildlife Action Plan (Kart et al. 2005), threats to the species include the construction of large dams on rivers which obstruct juvenile fish access to critical rearing habitats, as well as mortality associated with passing through hydroelectric facilities' turbines during their outmigration to sea.

As outlined in Vermont's Wildlife Action Plan (Kart et al. 2005), research and monitoring needs for this SGCN include determining their distribution and abundance, as the contribution of eels in northern regions to overall stock is unknown. One of the conservation strategies for this species is to support efforts to enhance access of American eels to Vermont waters by eliminating or minimizing impacts of dams and other obstructions along the Richelieu, St. Lawrence, and Connecticut Rivers.

The Atlantic States Marine Fisheries Commission has developed two documents related to the management of American eel:

1. <u>Interstate Fishery Management Plan for American Eel</u>. April 2000. Atlantic States Marine Fisheries Commission.
2. <u>Addendum II to the Fishery Management Plan for American Eel</u>. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

Objectives of the management plan include: (1) protect and enhance American eel abundance in all watershed where eel now occur; and (2) where practical, restore American eel to those waters where they had historical abundance but may now be absent by providing access to inland waters for glass eel, elvers, and yellow eel and adequate escapement to the ocean for pre-spawning adult eel.

Addendum II contains specific recommendations for improving upstream and downstream passage of American eel, including requesting that member states and jurisdictions seek special consideration for American eel in the FERC relicensing process.

The Connecticut River Atlantic Salmon Commission (CRASC) was established by Congress in 1983 (and reauthorized in 2002 for another 20 years) through the Connecticut River Atlantic Salmon Compact (Public Law 98-138). The Vermont Fish and Wildlife Department is a CRASC member agency, and a senior biologist from the department serves on the Technical Committee. The CRASC developed <u>A Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin</u> in 2005. The goal of the plan is "to protect and enhance the abundance of the American eel resource to ensure its continued role in the Connecticut River Basin ecosystem…" Management objectives in the plan include the following:

1. Protect and enhance eel populations where they currently exist;
2. Where practical, restore populations to waters where they had historical abundance;

3. Provide effective upstream and downstream fish passage around dams and other barriers within the species' range in the basin; and
4. Comply with all requirements of the Fishery Management Plan of the ASMFC.

Based on these plans, the Agency seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:
1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to downstream passage of American eel, the Agency's goals are:
1. Minimize current and potential negative project operation effects that could hinder management goals and objectives.
2. Minimize project-related sources of downstream passage delay, injury, stress, and mortality in order to maximize the number of silver eels migrating to the spawning grounds.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq*.), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq*.), and the Federal Power Act (16 U.S.C. §791a, *et seq*.).

Public Interest Consideration

The requester is a state resource agency.

Existing Information

The PAD contains information on the biology and life history of the American eel. It also summarizes eel collection data within the Vernon and Bellows Falls project areas. Eels have been collected both upstream and downstream of the Vernon Project and also have been counted passing the upstream anadromous fish ladder. Eels also have been documented upstream of the Bellows Falls and Wilder projects.

To date, no directed studies of eel entrainment or mortality have been conducted at any of the projects. These information gaps need to be filled so resource agencies can assess the relative and cumulative impact of project operations on outmigrating eels and develop adequate passage and protection measures to meet management goals and objectives.

We also note that within the past seven years, the USFWS has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005 the USFWS issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for

Endangered Species Act Reliability (CESAR). On September 29, 2011 the USFWS issued a substantial 90-day finding and initiated a 12-month status review. The USFWS is still accepting new American eel information for the ongoing status review. The USFWS also is currently in settlement negotiations with CESAR on their legal complaint that the USFWS failed to complete the 12-month finding within the statutory timeframe. Although the date for completion of the USFWS's 12-month finding on the latest petition is uncertain, it is likely that it will be made before any new licenses are issued for the projects.

Project Nexus
The Vernon, Bellows Falls, and Wilder projects operate as peaking facilities, except during periods when inflow exceeds the hydraulic capacities of the stations. Silver eels outmigrate during the mid- summer through late fall, a time of year when flows are generally within the operating capacities of the stations. Therefore, the projects would be expected to spill infrequently during the silver eel outmigration.

The project configurations present problems with respect to providing safe, timely and effective passage for outmigrating eels. The intakes likely are deep and, while no specification for the trashracks were provided in the PADs, it is unlikely that they would prevent impingement and/or entrainment of eels. Existing anadromous downstream passage facilities at the projects also would not be expected to be effective for eels; the target anadromous species are surface-oriented, while eels tend to move much deeper in the water column. Eels are known to occur upstream of the dams; therefore, it is necessary to understand how eels move through the projects and the level of injury or mortality caused by entrainment through the projects' turbines.

Proposed Methodology
In order to understand the movements of outmigrating silver eels as they relate to operations at the Vernon, Bellows Falls, and Wilder projects, radio telemetry technology should be utilized. Radio telemetry is an accepted technology that has been used for a number of studies associated with hydropower projects, including at the Muddy Run Project (FERC No. 2355).

Studies should be designed to investigate route selection (i.e., entrainment vs. spill) independently from estimation of mortality/injury, because these metrics require different telemetric methodologies. Studies also will likely benefit from data collected over both study years (especially route selection studies, which may be more significantly affected by environmental conditions during a given season that mortality/injury studies). It is also envisioned that results from route selection studies can guide design of turbine mortality studies. Therefore, it is proposed, at a minimum, that route selection studies be conducted in multiple years, but mortality/injury studies may be conducted after the first year of route selection studies has been completed.

1. Objective 1: Route Selection
This study will involve systematic releases of radio-tagged silver phase eels at strategic points above areas of interest, to assess general routes of passage (i.e., via spill, bypass, or turbines). Active downstream migrants should be collected within-basin if possible (i.e., Cabot or Holyoke bypass samplers), but fish sourced from out of basin may be

acceptable to meet sample size demands. Experimental fish must meet morphometric (e.g. eye diameter relative to body size) criteria to ensure they are migrant silver phase. Collections should be made within the migratory season (late Aug to mid Oct), and eels should be tagged and released within 21 days after capture, but preferably within seven days (particularly if the test eels are from out-of-basin).

All telemetered eels will be radio and passive integrated transponder (PIT) tagged. PIT antennas will be installed at bypasses at Vernon and Bellows Falls and monitored continuously to verify passage of eels via bypass channels.

<u>Vernon Project Route Selection Study</u>:
A minimum number of 50 telemetered eels (e.g., 5 separate groups of approximately 10 eels each) will be required to maximize the data return. Tagged eels should be released at least 5 km upstream of the Vernon project. Groups of eels should be released during spill and non-spill periods if possible. Telemetry receivers and antennas should be located to assess passage via the following potential routes: Vernon spillway; Fishway attraction water intake (if operational); Vernon downstream bypasses; and Vernon Station turbines.

Eels from the Bellows Falls route studies migrating to the Vernon Dam may be used to supplement (but not serve in lieu of) these release groups.

<u>Bellows Falls Dam Route Selection Study:</u>
A minimum number of 50 telemetered eels (e.g., 5 separate groups of approximately 10 eels each) will be required to maximize the data return. Groups of eels should be released during spill (if any) and non-spill and during periods of low, moderate, and high generation conditions, if possible. Tagged eels should be released at least 5 km upstream of the Bellows Falls Dam. If significant spillage occurs during releases, up to 50 additional eels should be released in the upper canal and allowed to volitionally descend through the canal to assure that sufficient number of eels are exposed to canal and powerhouse intake conditions. Telemetry receivers and antennas should be located upstream and downstream of the spillway, at the canal entrance, within the canal, in the fish downstream fish bypass entrance and turbine intakes and in mainstem below Bellows Falls Station to assess passage via the following potential routes: entrainment into the canal; passage over the spillway; into the upstream fishway attraction water intake (this should operate during the study to assess its use by eels as it may be operational in the future for riverine or eel passage as addressed in the Resident Fish Passage study request); the downstream fish bypass; and station turbines.

Eels from the Wilder route study migrating to the Bellow Falls Project may be used to supplement (but not serve in lieu of) these release groups.

<u>Wilder Project Route Selection Study:</u>
A minimum number of 50 telemetered eels (e.g., 5 separate groups of approximately 10 eels each) should be required to maximize the data return.

Tagged eels should be released at least 5 km upstream of the Wilder Project. Groups of eels should be released during spill and non-spill periods if possible. Telemetry receivers and antennas should be located to assess passage via the following potential routes: Wilder spillway; Fishway attraction water intake (if operational); Wilder downstream bypasses; and Wilder Station turbines.

Mobile tracking (i.e., via boat) in river reaches between release sites and several km downstream of Vernon Station will be performed at regular intervals during and after releases to confirm routes and fates of passed fish, or fish lost to follow-up.

Movement rates (time between release and detection at radio antenna locations, and between radio antenna locations) of eels passing the projects by various routes will also be quantified.

The route selection portion of this study should occur in both study years.

2. **Objective 2: Spill, Bypass, and Turbine Mortality/Injury Studies**
Spill, bypass, and turbine mortality will be assessed using a radio-telemetric balloon tag method. A minimum number of 50 tagged eels (e.g., 5 separate groups of approximately 10 eels each) will be required at each location (dam spillways, downstream bypasses, and station turbines) to maximize the data return.

For spill mortality sites (dam spillways and downstream bypasses), tagged eels will be injected or released into spill flow at points where water velocity exceeds 10 ft/sec, to minimize the possibility of eels swimming upstream into the headpond or canal. Passed balloon-tagged eels will be recovered below areas of spill and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged eels will be censored from the data.

For turbine mortality sites (Vernon, Bellows Falls, and Wilder stations), tagged eels will be injected into intakes of units operating at or near full generation at points where intake water velocity exceeds 10 ft/sec, to minimize the possibility of eels swimming back upstream through the intakes. Passed balloon-tagged eels will be recovered in the tailrace and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged eels will be censored from the data.

If the balloon tag mortality component of the study occurs in Study Year 1 then all possible route selection sites would need to be evaluated. If the balloon tag mortality component of the study occurs in Study Year 2, then results from the route selection study (Year 1) could be used to inform which sites need to be evaluated for mortality.. Eels recovered from balloon tag studies should not be used for route selection studies.

Data analyses of route selection and turbine mortality (instantaneous and latent) will follow standard methodology.

Project operation (flows, levels, gate openings, number of units operating and operation level) and environmental conditions (river flow, temperature, turbidity, air temperature, precipitation) will be monitored regularly (hourly measurements if possible) throughout the duration of the studies.

These methodologies are consistent with accepted practice.

Level of Effort and Cost

The level of cost and effort for the downstream eel passage study would be moderate to high; silver eels would need to be collected, tagged, and released in several locations over the course of the migration season. Antennas and receivers would need to be installed at the intakes of all stations as well as at the dam spillways and Station bypasses, and monitored regularly. Data would need to be retrieved periodically, then analyzed. A multi-site route selection study conducted by the USGS Conte Lab on the Shetucket River in Connecticut cost approximately $75,000 for the first year of study. Costs are estimated at $100,000 per year for the Route Selection studies and $75,000 per year for the Spill, Bypass, and Turbine Mortality/Injury Studies, for each project.

The applicant did not propose any studies to meet this need in the PAD.

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Brown, L.S. 2005. Characterizing the downstream passage behavior of silver phase American eels at a small hydroelectric facility. M.Sc. Thesis, Department of Natural Resource Conservation, University of Massachusetts, Amherst, Massachusetts. 110 pp.

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EPRI (Electric Power Research Institute). 2001. Review and documentation of research and technologies on passage and protection of downstream migrating catadromous eels at hydroelectric facilities. EPRI Technical Report No. 1000730, Palo Alto, California 270 pp.

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Turners Falls Hydroelectric Project – FERC No. 1889-081
Northfield Mountain Pumped Storage Project – FERC No. 2485-063

Study Request 21: Downstream American eel passage

Goals and Objectives

The goal of this study is to determine the impact of two hydroelectric projects on the outmigration of silver eels in the Connecticut River. Entrainment of eels at the Northfield Mountain Pumped Storage Station (NFMPS) removes eels from the river, effectively extirpating them from the population. Entrainment at the conventional turbines at Station 1 and Cabot Station of the Turners Falls Project can result in mortality or injury. It is important to understand the passage routes at each project and the potential for mortality to assess alternative management options to increase survival.

The objectives of this study are:

1. Quantify the movement rates (including delays) and relative proportion of eels passing via various routes at the projects; i.e. for NFMPS, the proportion entrained into the intake; for Turners Falls Dam, the proportion entrained into the power canal and spilled via bascule and Tainter gates; for the Cabot Canal, proportion of fish passing via spillways, turbines, and the downstream bypass.
2. Evaluate instantaneous and latent mortality and injury of eels passed via the Turners Falls Dam routes, including bascule and Tainter gates, spillways, turbines, and the downstream bypass.

Resource Management Goals

The Agency's goals related to aquatic natural resources are to:

1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.
4.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.

2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Vermont Fish and Wildlife Department's Strategic Plan (2002 -2010) focuses towards four major areas of concern: resource conservation, fish and wildlife-based recreation and use, human health and safety, efficient operations, and effective management.

The American eel (*Anguilla rostrata*), is listed as one of both New Hampshire's and Vermont's Species of Greatest Conservation Need (SGCN). The status for conservation need in Vermont is listed as high priority (Kart et al. 2005), and the species is listed as "vulnerable" in New Hampshire. As identified in Vermont's Wildlife Action Plan (Kart et al. 2005), threats to the species include the construction of large dams on rivers which obstruct juvenile fish access to critical rearing habitats, as well as mortality associated with passing through hydroelectric facilities' turbines during their outmigration to sea.

As outlined in Vermont's Wildlife Action Plan (Kart et al. 2005), research and monitoring needs for this SGCN include determining their distribution and abundance, as the contribution of eels in northern regions to overall stock is unknown. One of the conservation strategies for this species is to support efforts to enhance access of American eels to Vermont waters by eliminating or minimizing impacts of dams and other obstructions along the Richelieu, St. Lawrence, and Connecticut Rivers.

The Atlantic States Marine Fisheries Commission has developed two documents related to the management of American eel:
1. <u>Interstate Fishery Management Plan for American Eel</u>. April 2000. Atlantic States Marine Fisheries Commission.
2. <u>Addendum II to the Fishery Management Plan for American Eel</u>. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

Objectives of the management plan include: (1) protect and enhance American eel abundance in all watershed where eel now occur; and (2) where practical, restore American eel to those waters where they had historical abundance but may now be absent by providing access to inland waters for glass eel, elvers, and yellow eel and adequate escapement to the ocean for pre-spawning adult eel.

Addendum II contains specific recommendations for improving upstream and downstream passage of American eel, including requesting that member states and jurisdictions seek special consideration for American eel in the FERC relicensing process.

In addition, the Connecticut River Atlantic Salmon Commission (CRASC) developed <u>A Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin</u> in 2005. The goal of the plan is "to protect and enhance the abundance of the American eel resource to ensure its continued role in the Connecticut River Basin ecosystem…" Management objectives in the plan include the following:
1. Protect and enhance eel populations where they currently exist;

2. Where practical, restore populations to waters where they had historical abundance;
3. Provide effective upstream and downstream fish passage around dams and other barriers within the species' range in the basin; and
4. Comply with all requirements of the Fishery Management Plan of the ASMFC.

Based on these plans, the Agency seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:
1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to downstream passage of American eel, the Agency's goals are:
1. Minimize current and potential negative project operation effects that could hinder management goals and objectives.
2. Minimize project-related sources of downstream passage delay, injury, stress, and mortality in order to maximize the number of silver eels migrating to the spawning grounds.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq*.), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq*.), and the Federal Power Act (16 U.S.C. §791a, *et seq*.).

Public Interest Consideration

The requester is a resource agency.

Existing Information

The PAD contains information on the biology, life history, and regulatory status of American eel. It also discusses 2-D and 3-D telemetry studies that were conducted at Cabot Station in 1996, 1997, 2002 and 2003. Results of those studies indicate that a significant proportion of eels entering the Cabot forebay become entrained (90% in 2002, 100% in 2003; Brown 2005, Brown et al. 2009). The PAD notes that the study done in 2003 determined that 15 of the 29 test eels were detected at the Hadley Falls Station. However, that study was not designed to assess turbine mortality.

To date, no directed studies of eel mortality at Cabot Station or eel entrainment or mortality at either Station 1 or the NFMPS facility have been conducted. These information gaps need to be filled so resource agencies can assess the relative and cumulative impact of project operations on outmigrating eels and develop adequate passage and protection measures to meet management goals and objectives.

We also note that within the past seven years, the USFWS has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November

18, 2004. On July 6, 2005 the USFWS issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability (CESAR). On September 29, 2011 the USFWS issued a substantial 90-day finding and initiated a 12-month status review. The USFWS is still accepting new American eel information for the ongoing status review. The USFWS also is currently in settlement negotiations with CESAR on their legal complaint that the USFWS failed to complete the 12-month finding within the statutory timeframe. Although the date for completion of the USFWS's 12-month finding on the latest petition is uncertain, it is likely that it will be made prior to any new licenses are issued for the projects.

Project Nexus

The Turners Falls Project operates as a peaking facility, except during periods when inflow exceeds the hydraulic capacity of Cabot Station and Station 1. Silver eels outmigrate during the mid- summer through late fall, a time of year when flows are generally near the maximum operating capacity of the stations. Therefore, the project would be expected to spill infrequently during the silver eel outmigration beyond the nominal amount required in the bypass reach.

Racks at Cabot Station, Station 1, and NFMPS facility are not designed to protect eels from entrainment. At Cabot, the racks have one-inch clear spacing on the top 11-feet, with five-inch clear spacing on the bottom 20 feet of racks. The approach velocity at the racks is approximately 2.0 feet per second at maximum hydraulic capacity. At Station 1, the racks have 2.6-inch clear spacing and an approach velocity of 1.2 feet per second. Eels can readily pass through a 2.6-inch clear space. NFMPS has 48-foot-deep trashracks with six-inch clear spacing over the intake and an approach velocity of 3.5 feet per second at full pumping capacity (15,000 cfs).

As mentioned above, previous studies conducted at Cabot Station documented eel entrainment. Cabot Station has existing downstream passage facilities designed for anadromous species, but studies have documented few eels utilizing the surface bypass (likely because Cabot has a relatively deep, wide intake area). Station 1 has no passage and protection facilities. NFMPS has a seasonally-deployed barrier net to minimize entrainment of Atlantic salmon smolts, but it is only operated from April through June 15 annually. While no studies have been conducted at Station 1 or NFMPS facility, the rack spacing is wide enough to allow for entrainment.

Proposed Methodology

In order to understand the movements of outmigrating silver eels as they relate to operations at the Northfield Mountain Pump Storage Facility, Station 1, and Cabot Station, radio telemetry technology should be utilized. Radio telemetry is an accepted technology that has been used for a number of studies associated with hydropower projects, including at the Muddy Run Project (FERC No. 2355).

Studies should be designed to investigate route selection (i.e., entrainment vs. spill) independently from estimation of mortality/injury, because these metrics require different telemetric methodologies. Studies also will likely benefit from data from several seasons (especially route selection studies, which may be more significantly affected by environmental conditions during a given season that mortality/injury studies). It is also envisioned that results from route selection studies can guide design of turbine mortality studies. Therefore, it is proposed, at a minimum, that route selection studies be conducted in multiple years, but mortality/injury studies may be conducted after the first year of route selection studies have been completed.

1. Objective 1: Route Selection
   This study will involve systematic releases of radio-tagged silver phase eels at strategic points above areas of interest, to assess general routes of passage (i.e., via spill, bypass, or turbines). Active downstream migrants should be collected within-basin if possible (i.e., Cabot or Holyoke bypass samplers), but fish sourced from out of basin may be acceptable to meet sample size demands. Experimental fish must meet morphometric (e.g. eye diameter relative to body size) criteria to ensure they are migrant silver phase. Collections should be made within the migratory season (late Aug to mid Oct), and eels should be tagged and released within 7 days of collection.

   NFMPS Route Selection Study:
   A minimum number of 50 telemetered eels (e.g., 5 separate groups of approximately 10 eels each) will be required to maximize the data return. Eels will be released at least 5 km upstream of the NFMPS project; releases should be timed so that there is a significant probability that migrating eels will encounter NFMPS during the pumping stage. Radio telemetry antennas will be strategically placed to determine times eels are present within the river reach in the vicinity of the NFMPS intakes, within the intakes themselves, and whether they are entrained into the upper reservoir.

   Turners Falls Dam Route Selection Study:
   A minimum number of 50 telemetered eels (e.g., 5 separate groups of approximately 10 eels each) will be required to maximize the data return. Groups of eels should be released during spill and non-spill periods if possible. Tagged eels will be released at least 3 km upstream of the Turners Falls dam but several km below the intake to NFMPS. Telemetry receivers and antennas will be located above and below the dam to assess passage via the following potential routes: entrainment into power canal; passage via spill over the bascule gates; passage via spill through the Tainter gates.

   Eels from the NFMPS route study not entrained into the NFMPS intake and migrating to the Turners Falls Dam may be used to supplement (but not serve in lieu of) these release groups.

   Turners Falls Project – Canal Route Selection Study:
   A minimum number of 50 telemetered eels (e.g., 5 separate groups of approximately 10 eels each) will be required to maximize the data return. Groups of eels should be released during periods of low, moderate, and high generation conditions if possible. Eels will be released in the upper canal (ideally just downstream of the Gatehouse), and allowed to volitionally descend through the

canal. Telemetry receivers and antennas will be located within the canal, bypass, channel, and mainstem below Cabot Station to assess passage via the following potential routes: Spillway Fishway attraction water intake (if operational); Station 1 turbines; Cabot Station spillway; Cabot Station bypass; Cabot Station turbines

Eels from the NFMPS and Turners Falls Dam Route Studies not entrained into the NFMPS intake and migrating into the Turners Falls Canal may be used to supplement (but not serve in lieu of) these release groups.

Mobile tracking (i.e., via boat) in river reaches between release sites and several km downstream of Cabot Station will be performed at regular intervals during and after releases to confirm routes and fates of passed fish, or fish lost to follow-up.

Movement rates (time between release and passage) of eels passing the projects by various routes will also be quantified.

The route selection portion of this study should occur in both study years.

2. Objective 2: Spill, Bypass, and Turbine Mortality/Injury Studies
Spill, bypass, and turbine mortality will be assessed using a radio-telemetric balloon tag method. A minimum number of 50 tagged eels (e.g., 5 separate groups of approximately 10 eels each) will be required at each location (dam bascule gate, dam Tainter gate, Cabot Station spillway, Cabot Station bypass, Station 1 and Cabot Station) to maximize the data return. Turbine mortality studies are not required at NFMPS because it is assumed that all entrained fish (including eels) are lost to the Connecticut River system.

For spill mortality sites (dam bascule gate, dam Tainter gate, Cabot spillway, Cabot Station bypass), tagged eels will be injected or released into spill flow at points where water velocity exceeds 10 ft/sec, to minimize the possibility of eels swimming upstream into the headpond or canal. Passed balloon-tagged eels will be recovered below areas of spill and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged eels will be censored from the data.

For turbine mortality sites (Station 1 and Cabot Station), tagged eels will be injected into intakes of units operating at or near full generation at points where intake water velocity exceeds 10 ft/sec, to minimize the possibility of eels swimming back upstream through the intakes. Passed balloon-tagged eels will be recovered in the tailrace and held for 48 hours in isolated tanks for observation of injury and latent mortality; unrecovered balloon-tagged eels will be censored from the data.

Mobile tracking (i.e., via boat) in river reaches between release sites and several km downstream of Cabot Station will be performed at regular intervals after releases to confirm routes and fates of passed fish, or fish lost to follow-up.

The turbine mortality component of the study should occur in Study Year 2.

Data analyses of route selection and turbine mortality (instantaneous and latent) will follow standard methodology.

Project operation (flows, levels, gate openings, number of units operating and operation level) and environmental conditions (river flow, temperature, turbidity, air temperature, precipitation) will be monitored regularly (hourly measurements if possible) throughout the duration of the studies.

These methodologies are consistent with accepted practice.

Level of Effort and Cost

The level of cost and effort for the downstream eel passage study would be moderate to high; silver eels would need to be collected, tagged, and released in several locations over the course of the migration season. Antennas and receivers would need to be installed at the intakes to all stations as well as at the Turners Falls dam spillway and Cabot Station bypass, and monitored regularly. Data would need to be retrieved periodically, then analyzed. A multi-site route selection study conducted by the USGS Conte Lab on the Shetucket River in Connecticut cost approximately $75,000 for the first year of study. Cost are estimated at $100,000 per year for the Route Selection studies and $75,000 per year for the Spill, Bypass, and Turbine Mortality/Injury Studies.

In the PAD, the applicant has identified the need to assess issues related to downstream passage for American eels at the project, but indicates that it intends to rely on information from previously conducted studies and ongoing studies. The USFWS is not aware of any previously conducted or ongoing studies related to downstream eel passage.

Literature Cited

Brown, L.S. 2005. Characterizing the downstream passage behavior of silver phase American eels at a small hydroelectric facility. M.Sc. Thesis, Department of Natural Resource Conservation, University of Massachusetts, Amherst, Massachusetts. 110 pp.

Brown, L., A. Haro, and T. Castro-Santos. 2009. Three-dimensional movement of silver-phase American eels in the forebay of a small hydroelectric facility. Pages 277-291in: J. Casselman et al. editors. Eels at the Edge: Science, Status, and Conservation Concerns. American Fisheries Society, Bethesda, MD.

EPRI (Electric Power Research Institute). 2001. Review and documentation of research and technologies on passage and protection of downstream migrating catadromous eels at hydroelectric facilities. EPRI Technical Report No. 1000730, Palo Alto, California 270 pp.

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Vermont Fish and Wildlife Department . 2006. Vermont Fish and Wildlife Strategic Plan. http://www.vtfishandwildlife.com/library/reports_and_documents/Fish_and_wildlife/Strategic_Plan.pdf

Wilder Hydroelectric Project – FERC No. 1892-026
Bellows Falls Hydroelectric Project – FERC No. 1855-045
Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 22: Upstream American eel passage assessment

Goals and Objectives

This study has two objectives:

1. Conduct systematic surveys of eel presence/abundance at tailrace and spillway locations at the Vernon, Bellows Falls, and Wilder projects to identify areas of concentration of eels staging in pools or attempting to ascend wetted structures that would potentially establish the most effective locations to place upstream eel passage facilities.
2. Collect eels with temporary trap/pass devices from areas identified from surveys as potential locations of eel concentration to assess whether eels can be collected/passed in substantial numbers, and whether locations are viable sites for permanent eel trap/pass structures.

Resource Management Goals

The American eel (*Anguilla rostrata*), is also one of New Hampshire and Vermont's Species of Greatest Conservation Need (SGCN). The status for conservation need in Vermont is listed as high priority (Kart et al. 2005), and the species is listed as "vulnerable" in New Hampshire. As identified in Vermont's Wildlife Action Plan (Kart et al. 2005), threats to the species include the construction of large dams on rivers which obstruct juvenile fish access to critical rearing habitats, as well as mortality associated with passing through hydroelectric facilities' turbines during their outmigration to sea.

As outlined in Vermont's Wildlife Action Plan (Kart et al. 2005), research and monitoring needs for this SGCN include determining their distribution and abundance, as the contribution of eels in northern regions to overall stock is unknown. One of the conservation strategies for this species is to support efforts to enhance access of American eels to Vermont waters by eliminating or minimizing impacts of dams and other obstructions along the Richelieu, St. Lawrence, and Connecticut Rivers.

The Atlantic States Marine Fisheries Commission has developed two documents related to the management of American eel:

1. <u>Interstate Fishery Management Plan for American Eel</u>. April 2000. Atlantic States Marine Fisheries Commission.
2. <u>Addendum II to the Fishery Management Plan for American Eel</u>. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

In addition, the Connecticut River Atlantic Salmon Commission (CRASC) developed the draft document: <u>A Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin</u> in 2005. The goal of the plan is "to protect and enhance the abundance of the American eel resource to ensure its continued role in the Connecticut River Basin ecosystem…" Management objectives in the plan include the following:

1. Protect and enhance eel populations where they currently exist;
2. Where practical, restore populations to waters where they had historical abundance;
3. Provide effective upstream and downstream fish passage around dams and other barriers within the species' range in the basin; and
4. Comply with all requirements of the Fishery Management Plan of the ASMFC.

Based on these plans, the Agency seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the three projects. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to upstream passage of American eel, the Agency's goals are:

1. Minimize current and potential negative project operation effects that could hinder management goals and objectives.
2. Minimize project-related sources of upstream passage delay, injury, and stress in order to facilitate access to historical rearing habitat.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq*.), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq*.), and the Federal Power Act (16 U.S.C. §791a, *et seq*.).

Public Interest Consideration

The requester is a resource agency.

Existing Information

The PAD contains no information relative to areas where eels seeking to move upstream concentrate downstream of the three dams, or annual numbers of eels attempting to ascend past the dams. While eels have been known to ascend the Vernon and Bellows Falls fish ladders, their efficiency for passing eels is unknown, and they are only operated during the American shad passage season (from April 15 through July 15). Eels are currently able to pass Vernon, Bellows Falls, and Wilder dams (as evidenced by documented presence of eels upstream), but the total number of eels attempting to pass all three dams and the proportion successfully passing each project is unknown (but suspected to be low). The downstream Holyoke Project has operated upstream eel passage facilities since 2004. Last year these facilities passed over 40,000 juvenile eels. While the next dam upstream (the Turners Falls Project; FERC No. 1889) has no dedicated upstream eel passage facilities, eels have been known to ascend the Cabot Station fish ladder (A. Haro, U.S. Geological Survey, pers. comm.). Although there is rearing habitat in between the Turners Falls and Vernon dams, some eels will attempt to continue upstream, and passage needs to be provided so these fish can access historical habitat.

These information gaps need to be filled so resource agencies can determine the best locations to site upstream eel passage facilities and assess whether operating the existing anadromous ladders would be an effective mechanism to move juvenile eels upstream past the projects.

We also note that within the past seven years, the USFWS has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005 the USFWS issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability (CEASAR). On September 29, 2011 the USFWS issued a substantial 90-day finding and initiated a 12-month status review. The USFWS is still accepting new American eel information for the ongoing status review. The USFWS also is currently in settlement negotiations with CESAR on their legal complaint that the USFWS failed to complete the 12-month finding within the statutory timeframe. Although the date for completion of the USFWS's 12-month finding on the latest petition is uncertain, it is likely that it will be made before any new licenses are issued for the projects.

Project Nexus

The three projects generate hydropower on the head created by the Vernon, Bellows Falls, and Wilder dams. These dams create barriers to upstream migrating eels. While some eels are able to pass dams, some are not, and the passability of a given dam depends on factors such as its height, hydraulics, presence of climbable surfaces, presence of predators, risk of exposure to heat or drying while climbing a dam, etc. All three dams are high (Vernon: 58 ft. high; Bellows Falls: 30 ft. high; and Wilder: 60 ft. high), and the majority of the dam faces are dry during most of the upstream eel passage season. Design of the dams is not currently amenable to passage of eels by climbing. As mentioned earlier, the existing anadromous passage facilities are not designed to pass eels, and even if some eels are able to ascend the ladders, they may incur delays (in attraction or passage rates), be size-selective (e.g. velocity barrier for small eels presented by ~8 ft/sec flow through weirs and orifices), present a potential predation risk (predators in or near the fishways), and are not operated throughout the upstream eel passage season.

Proposed Methodology

Objective 1: Systematic Surveys

Surveys of eel presence and relative abundance should be conducted at regular intervals throughout the eel upstream migratory season (~1 May to ~15 October, or when river temperatures exceed 10 C). Surveys should consist of visual inspection and trapping in likely areas where eels may concentrate as they attempt to climb structures wetted by significant spill or leakage flow below the dams and associated structures. These locations include: the upstream fish ladders at all three projects (dewatered state) and leakage or overflow points along the downstream faces of all three dams, including spillways. Methods should include visual surveys (on foot, from a boat, or snorkeling) and trapping using small mesh (< 1/8” clear opening) baited eel pots. Visual surveys should be performed once per week, at night, preferentially during precipitation events. Trap sets should be performed once per week, with an overnight soak time. Recorded data should include location, observation of eels (presence, absence, relative numbers, relative sizes, behaviors, time/date of observation), and survey method.

Objective 2: Trap/Pass Collections

Areas identified from Systematic Surveys as having significant number of eels present should be targeted as potential areas for permanent eel trap/passes, and should be initially assessed using temporary/portable trap passes. At a minimum (regardless of survey results), temporary trap passes should be installed at stilling basins and/or lower sections of fishways supplied with minimal attraction flow (0.5-1.0 cfs) during dewatered conditions at all three projects , as these locations may be supplemented with additional attraction flow and have high potential for being concentration points for upstream migrant eels. Similarly, traps should also be placed at spillway or bypass channel locations where eels have a potential to climb wetted (e.g., via leakage) flow zones, at the highest points where eels are able to climb to, or where otherwise feasible. Temporary trap/passes should be purpose-designed and built for each location, and operated throughout the eel upstream migratory season (~1May to 15 October, or when river temperatures exceed 10° C). Ramp-type traps with supplementary attraction flow are preferred temporary trap/pass designs. Traps should operate daily, with catches quantified every 2-3 days. Recorded data should include location, trapping interval, absolute numbers of eels trapped, relative eel sizes, and hydraulic and environmental conditions during the trapping period.

All collected eels from surveys should be released at their point of capture; those eels collected from trap/pass collections should be transported to and released into the headponds upstream of where they were collected.

These methodologies are consistent with accepted practice.

Level of Effort and Cost

The level of cost and effort for the survey component of the study would be low for each individual project (moderate for all three projects combined); a minimal number of personnel may be able to conduct the weekly surveys. The trap/pass component would require low to moderate cost and effort. We estimate $40,000 per project to conduct this study.

The Agency is not aware of any previously conducted or ongoing studies related to upstream eel passage. The applicant did not propose any studies to meet this need in the PAD.

Literature Cited

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department. Waterbury, Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm. (Accessed September 10, 2012).

Vermont Fish and Wildlife Department . 2006. Vermont Fish and Wildlife Strategic Plan. http://www.vtfishandwildlife.com/library/reports_and_documents/Fish_and_wildlife/Strategic_Plan.pdf

Turners Falls Hydroelectric Project – FERC No. 1889-081

Study Request 22: Upstream American eel passage assessment

Goals and Objectives

This study has two objectives:

1. Conduct systematic surveys of eel presence/abundance at Cabot Station discharge, Station #1 discharge, canal discharges, and Turners Falls Dam to identify areas of concentration of eels staging in pools or attempting to ascend wetted structures that would potentially establish the most effective locations to place upstream eel passage facilities.
2. Collect eels with temporary trap/pass devices from areas identified from surveys as potential locations of eel concentration to assess whether eels can be collected/passed in substantial numbers, and whether locations are viable sites for permanent eel trap/pass structures.

Resource Management Goals

The Agency's goals related to aquatic natural resources are to:

1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Vermont Fish and Wildlife Department's Strategic Plan (2002 -2010) focuses towards four major areas of concern: resource conservation, fish and wildlife-based recreation and use, human health and safety, efficient operations, and effective management.

The American eel (*Anguilla rostrata*), is listed as one of both New Hampshire's and Vermont's Species of Greatest Conservation Need (SGCN). The status for conservation need in Vermont is listed as high priority (Kart et al. 2005), and the species is listed as "vulnerable" in New Hampshire. As identified in Vermont's Wildlife Action Plan (Kart et al. 2005), threats to the species include the construction of large dams on rivers which obstruct juvenile fish access to critical rearing habitats, as well as mortality associated with passing through hydroelectric facilities' turbines during their outmigration to sea.

As outlined in Vermont's Wildlife Action Plan (Kart et al. 2005), research and monitoring needs for this SGCN include determining their distribution and abundance, as the contribution of eels in northern regions to overall stock is unknown. One of the conservation strategies for this species is to support efforts to enhance access of American eels to Vermont waters by eliminating or minimizing impacts of dams and other obstructions along the Richelieu, St. Lawrence, and Connecticut Rivers.

The Atlantic States Marine Fisheries Commission has developed two documents related to the management of American eel:

1. Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.
2. Addendum II to the Fishery Management Plan for American Eel. Atlantic States Marine Fisheries Commission. Approved October 23, 2008. 8 pp.

The Connecticut River Atlantic Salmon Commission (CRASC) was established by Congress in 1983 (and reauthorized in 2002 for another 20 years) through the Connecticut River Atlantic Salmon Compact (Public Law 98-138). The Vermont Fish and Wildlife Department is a CRASC member agency, and a senior biologist from the department serves on the Technical Committee. In addition, the Connecticut River Atlantic Salmon Commission (CRASC) developed A Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin in 2005. The goal of the plan is "to protect and enhance the abundance of the American eel resource to ensure its continued role in the Connecticut River Basin ecosystem…" Management objectives in the plan include the following:

1. Protect and enhance eel populations where they currently exist;
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3. Provide effective upstream and downstream fish passage around dams and other barriers within the species' range in the basin; and
4. Comply with all requirements of the Fishery Management Plan of the ASMFC.

Based on these plans, the Agency seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Project. General goals include the following:

1. Ensure that protection, mitigation and enhancement measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
2. Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific to upstream passage of American eel, the Agency's goals are:

1. Minimize current and potential negative project operation effects that could hinder management goals and objectives.

2. Minimize project-related sources of upstream passage delay, injury, and stress in order to facilitate access to historical rearing habitat.

Our study requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq*.), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq*.), and the Federal Power Act (16 U.S.C. §791a, *et seq*.).

Public Interest Consideration

The requester is a resource agency.

Existing Information

The PAD contains no information relative to areas where eels seeking to move upstream concentrate downstream of the dam, or annual numbers of eels attempting to ascend past Turners Falls Dam. While eels have been known to ascend the Cabot Station ladder (A. Haro, U.S. Geological Survey, pers. comm.), its efficiency is unknown, and it is only operated during the American shad passage season (from April 1 through July 15). Eels are currently able to pass the Turners Falls Dam complex (as evidenced by documented presence of eels upstream), but the total number of eels attempting to pass Turners Falls and the proportion successfully passing the project is unknown (but suspected to be low). The downstream Holyoke Project has operated upstream eel passage facilities since 2004. Last year these facilities passed over 40,000 juvenile eels. While there is rearing habitat in between the Holyoke and Turners Falls dams, some eels will attempt to continue upstream, and passage needs to be provided so these fish can access historical habitat.

These information gaps need to be filled so resource agencies can determine the best locations to site upstream eel passage facilities and assess whether operating the existing anadromous ladders would be an effective mechanism to move juvenile eels upstream past the project.

We also note that within the past seven years, the USFWS has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005 the USFWS issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007 with a finding that listing was not warranted. The second petition was filed on April 30, 2010 by the Council for Endangered Species Act Reliability (CESAR). On September 29, 2011 the USFWS issued a substantial 90-day finding and initiated a 12-month status review. The USFWS is still accepting new American eel information for the ongoing status review. The USFWS also is currently in settlement negotiations with CESAR on their legal complaint that the USFWS failed to complete the 12-month finding within the statutory timeframe. Although the date for completion of the USFWS's 12-month finding on the latest petition is uncertain, it is likely that it will be made before any new licenses are issued for the projects.

Project Nexus

The project generates hydropower on the head created by the Turners Falls dam. This dam creates a barrier to upstream migrating eels. While some eels are able to pass dams, some are not, and the passability of a given dam depends on factors such as its height, hydraulics, presence of climbable surfaces, presence of predators, risk of exposure to heat or drying while climbing a dam, etc. The Turners Falls dam is high (35 feet above bedrock), and the majority of the dam face is dry during most of the upstream eel passage season. Design of the dam is not currently amenable to passage of eels by climbing. While flow is released to the bypass reach via a bascule gate (typically the one closest to the gatehouse), this would not facilitate eel passage, as bascule gates open outward and downward (i.e., requiring the eels to essentially swim nearly upside down to get over the gate). As mentioned earlier, the existing anadromous passage facilities are not designed to pass eels, and even if some eels are able to ascend the ladders, they may incur delays (in attraction or passage rates), be size-selective (e.g. velocity barrier for small eels presented by ~8 ft/sec flow through weirs and orifices), present a potential predation risk (predators in or near the fishways), and are not operated throughout the upstream eel passage season.

Proposed Methodology

Objective 1: Systematic Surveys

Surveys of eel presence and relative abundance should be conducted at regular intervals throughout the eel upstream migratory season (~1 May to ~15 October, or when river temperatures exceed 10 C). Surveys should consist of visual inspection and trapping in likely areas where eels may concentrate as they attempt to climb structures wetted by significant spill or leakage flow in the Turners Falls dam complex area. These locations include: Cabot Station downstream bypass outfall, Cabot Station spillway (including attraction water stilling basin), Cabot Fishway (dewatered state), USGS Conte Lab flume outfall, Number One Station outfall, various small turbine and process water outfalls from the Cabot Canal, Spillway Fishway attraction water stilling basin, and leakage points along the downstream face of Turners Falls Dam (bascule and Tainter gates). Methods should include visual surveys (on foot, from a boat, or snorkeling) and trapping using small mesh (< 1/8” clear opening) baited eel pots. Visual surveys should be performed once per week, at night, preferentially during precipitation events. Trap sets should be performed once per week, with an overnight soak time. Recorded data should include location, observation of eels (presence, absence, relative numbers, relative sizes, behaviors, time/date of observation), and survey method.

Objective 2: Trap/Pass Collections

Areas identified from Systematic Surveys as having significant number of eels present should be targeted as potential areas for permanent eel trap/passes, and should be initially assessed using temporary/portable trap passes. At a minimum (regardless of survey results), temporary trap passes should be installed at the following locations: Cabot Fishway attraction flow stilling basin (during dewatered fishway period), Number One Station outfall, and Spillway Fishway attraction flow stilling basin (during watered and dewatered fishway period), as these locations may be supplemented with additional attraction flow and have high potential for being concentration points for upstream migrant eels. Temporary trap/passes should be purpose-designed and built for each location, and operated throughout the eel upstream migratory season (~1May to 15 October, or when river temperatures exceed 10 C). Ramp-type traps with supplementary attraction flow are preferred temporary trap/pass designs. Traps should operate daily, with catches quantified every 2-3 days. Recorded data should include location, trapping interval, absolute numbers of eels trapped, relative eel sizes, and hydraulic and environmental conditions during the trapping period.

All collected eels from surveys should be released at their point of capture; those eels collected from trap/pass collections should be transported to and released above the dam in the Turners Falls Pool.

These methodologies are consistent with accepted practice.

Level of Effort and Cost

The level of cost and effort for the survey component of the study would be low; a minimal number of personnel may be able to conduct the weekly surveys. The trap/pass component would require low to moderate cost (estimated at $40,000) and effort.

In the PAD, the applicant has identified the need to assess issues related to upstream passage for American eels at the project, but indicates that it intends to rely on information from previously conducted studies and ongoing studies. The USFWS is not aware of any previously conducted or ongoing studies related to upstream eel passage.

Wilder Hydroelectric Project – FERC No. 1892-026
Bellows Falls Hydroelectric Project – FERC No. 1855-045
Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 23: Impingement and entrainment of resident fish species at project intakes

Goals and Objectives
The goal of this study is to assess the adequacy of the intakes at Bellows Falls, Wilder, and Vernon projects to minimize fish mortality resulting from impingement and entrainment of fishes residing in the Connecticut River, and to recommend appropriate mitigative measures as necessary.
Specific objectives include:

- Describe the configuration of the intake at each project, including the forebay characteristics, size of the intakes, trashrack spacing and extent of coverage if the intakes, approach velocities and the influence of trashrack debris and cleaning protocols.
- Estimate the mortality rates for resident fish species and life stages that may result from impingement on project trashracks.
- Estimate the mortality rates for resident fish species and life stages that may result from entrainment and passage through the project turbines. Review existing Vermont Fish and Wildlife Department’s (VTFWD) fish passage data to increase sample size and gain a better understanding of temporal variability.
- Determine structural and operational measures that could be reduce fish mortality.

Resource Management Goals
Vermont Water Quality Standards (VWQS) seek to provide high quality aquatic habitat necessary to support healthy aquatic communities and the associated uses such as fishing.
The Agency’s goals related to aquatic natural resources and pertinent to this study request are to:

1. Provide for healthy, self-sustaining fish communities.
2. Minimize the potential negative effects of project operation on resident fish populations, and mitigate for losses.

Public Interest Consideration
The requestor is a state fish and wildlife agency.

Existing Information
The Connecticut River and the project impoundments support a variety of resident fish species as well as angling. However, there is no information about fish mortality and the population effects resulting from project impingement and entrainment. The project PADs contain almost no information about the project trashracks. During the ILP site visits held in October 2012 the Agency was informed that the rack spacing was in most cases four inches (on center) and as much as six inches in some cases. Further, these trashracks do not cover the entire intake area in all cases. No information on approach velocities has been provided. Mortality rates of fish passing through the turbines are not known.

Project Nexus

The Bellows Falls, Wilder and Vernon dams span across the Connecticut River, acting as a physical impediment to fish passage. Fishes living in the impoundments will at times enter project forebays and come in close proximity to project intakes. Impingement or entrainment is certainly occurring but the extent of this impact is unknown. The wide rack spacing is likely to result in entrainment.

The projects include downstream fish passage facilities but their use and effectiveness for resident fish species is unknown. These facilities are operated seasonally and therefore will not mitigate impingement and entrainment at all times.

Proposed Methodology

Impingement, entrainment and turbine mortality studies have been conducted at numerous other hydropower projects and can be used to assess potential fish mortality based on results from other projects with similar configurations.
Approach velocities can be calculated and actual measurements can be taken to quantify variability by location and verify calculated results.
Turbine mortality should be assessed by releasing tagged fish for downstream recovery. The details of this type of study should be addressed during the study plan stage.
The contribution of existing fish passage facilities to reducing impingement and entrainment of resident fishes should also be assessed.

Level of Effort and Cost

The expected level of effort and anticipated costs will be comparable or less than those experienced on similar FERC projects of this size.

Wilder Hydroelectric Project – FERC No. 1892-026
Bellows Falls Hydroelectric Project – FERC No. 1855-045
Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 24: Determine upstream passage needs for riverine fish species at project fishways

Goals and Objectives

The goal of this study is to determine the adequacy of the existing Bellows Falls, Wilder, and Vernon fish ladders in passing riverine species and determine the appropriate operation period for these fishways to pass riverine and diadromous fish.
Specific objectives include:

- Identify the utilization and temporal distribution, of passage through the Bellows Falls, Wilder, and Vernon fishways by riverine and diadromous fish species
- Review existing Vermont Fish and Wildlife Department's (VTFWD) fish passage data to increase sample size and gain a better understanding of temporal variability.
- Operate and monitor the fishways year-round (or until otherwise infeasible) to assess fishway use over a longer period than the fishways have traditionally been operated to:

    1. Determine the appropriate operating windows of the fishways for riverine species

    2. Determine the appropriate operating windows of the fishways for diadromous species such as American eel and sea lamprey.

Resource Management Goals

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Vermont Fish and Wildlife Department's Strategic Plan (2002 -2010) focuses towards four major areas of concern: resource conservation, fish and wildlife-based recreation and use, human health and safety, efficient operations, and effective management.

A mission of the New Hampshire Fish and Game Department (NHFGD) is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats.

Three of the NHFGD's goals are to ensure:

1. New Hampshire has a wide range of naturally occurring habitats and health, functioning ecosystems.
2. New Hampshire has abundant and varied fish, wildlife, and marine species at levels that ensure sustainable, healthy populations.
3. New Hampshire has fish, wildlife, and marine populations that support desirable levels of hunting, trapping, fishing, and wildlife viewing.

In order to be consistent with both Department's missions and goals, and to promote healthy fish populations, connectivity within a river system is important. By allowing fish to move through the fishway during different times of the year, and during different life history stages, access to available riverine aquatic habitat is increased. Fish are able to seek the best available habitat and food resources, as well as avoid predator interactions. Furthermore, movement within a river system promotes genetic diversity. Currently upstream resident fish passage at the Bellows Falls, Wilder, and Vernon dams is precluded most of the year due to fishway closure.

Public Interest Consideration
The requestor is a state natural resource agency.

Existing Information
No such information exists that will allow for a comprehensive assessment of existing year round fishway utilization by resident species. The VTFWD has several years (2007-2012) of seasonal passage data that have not yet been analyzed. These data are in the form of .avi files, but only include the spring and summer months (typically May- July).
The PAD acknowledges that "Resident species have also been recorded using the Bellows Falls and Wilder fish ladder". Those data are available from the Vermont Fish & Wildlife Department. Fish passage video data that have been processed should be available for distribution in the future (Lael Will, Vermont Fish & Wildlife, personal communication)". Although not comprehensive, analysis of these data would assist in filling this data gap.

In 2012, VTFWD staff documented resident species passage at the Vernon fishway. Species observed utilizing the fishway included bluegill (N = 555), common carp (N = 209), channel catfish (N = 37), trout sp. (N = 2), walleye (N = 54), white sucker (N = 102), and American eel (N =262). However, these analyses were conducted during one year and did not include any monitoring outside of the spring spawning run.

Project Nexus
The Bellows Falls, Wilder and Vernon dams span across the Connecticut River, acting as a physical impediment to fish passage. Therefore, the project has a direct impact on fish passage and limits fish from accessing available aquatic habitat located upstream of the dam.
The PAD acknowledges that "river fragmentation can reduce or obstruct fish and aquatic community connectivity and therefore genetic diversity and stock structure. However, those impacts are reduced by the provision of fish passage and the length of the impoundment. Upstream and downstream fish passages, designed for Atlantic salmon, are likely used by other migratory and resident species, providing connectivity; however, fish counts are limited,

unknown or unavailable for resident species". In fact, it is known that riverine and diadromous species use the fishways, but there has been limited analysis of this data and fishway monitoring was limited to spring period.

Therefore, in order to determine the level of riverine fish passage through the existing fishways, and the appropriate operation period for the fishway , review of existing data and , further monitoring of the fishways is warranted.

Proposed Methodology

Fishway monitoring has been conducted annually by VTFWD dating back to 1985. Monitoring was focused on Atlantic salmon, American shad and American eel. Resident species were recorded periodically, but were not monitored outside the spring anadromous fish migration period

Fishway monitoring has been used to assess existing and proposed project operations, and to develop appropriate operating windows for fisheries resources.

In addition to fish window count data, monitoring should include monitoring of the hydraulic conditions in the fishways and fishway entrances, and periodic fish observations should be made over the length of the fishways. If count data or observations of the fishways indicate the need for fishway operation changes or for more specific information on fish movement through the fishways, changes to the monitoring plan for year 2 monitoring would need to be implemented.

Level of Effort and Cost

This study will require video monitoring equipment, appropriate software (e.g. salmon soft), and personal to read to files, and manage the equipment. Some information already exists in the form of .avi files and past count data and are readily available from VTFWD. No other tool (e.g. radio telemetry) is more appropriate or cost effective for these types of assessments. Cost is relatively low.

Literature Cited

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department. Waterbury, Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm. (Accessed September 10, 2012).

Vermont Fish and Wildlife Department . 2006. Vermont Fish and Wildlife Strategic Plan. http://www.vtfishandwildlife.com/library/reports_and_documents/Fish_and_wildlife/Strategic_Plan.pdf

Wilder Hydroelectric Project – FERC No. 1892-026

Study Request 25: Impact of impoundment water level fluctuations on wetlands

Goals and Objectives

The goal of this study is to determine the impacts to wetlands from daily and seasonal water level fluctuation in the impoundment and downstream from the Wilder Hydroelectric Project to the head of the Bellows Falls impoundment.

The objectives of this study are to:

1. Identify all wetlands types, natural communities, and invasive species within the impoundment and downstream, and determine the proportion of wetlands and wetland type (i.e. emergent, shrub, forested) that are impacted by daily and seasonal water level fluctuations from project operations.
2. Determine the ratios of wetland types in the project area should be compared to previous national wetland inventory maps, and/or to reference conditions to determine if wetland types or natural communities within the project impoundment or downstream are being altered by project operations.
3. Determine how project operations are affecting the wetland plant community composition, including promoting the spread of invasive species or affecting rare, threaten, and endangered species.

Resource Management Goals

The Agency's goals related to aquatic natural resources are to:

1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

The goal of the Vermont Agency of Natural Resources is to identify and protect significant wetlands and the values and function which they ensure that there is no net loss of such wetlands and their function are achieved. Vermont classifies wetlands that are adjacent to streams, rivers, and open water that contain woody or persistent non-woody vegetation as Class II significant wetlands.

Public Interest Consideration
The requestor is a state natural resource agency.

Existing Information
The PAD does not address how wetlands type or wetland community composition that could be impacted by daily and seasonal water level fluctuations within the impoundment.

Project Nexus
The project impoundment extends 45 miles upstream from the dam. The project currently operates in a peaking mode, with allowable impoundment fluctuations of up to 5 feet, with proposals to continue as such. Wetlands can be affected by the operations of the hydropower project depending on frequency, timing, amplitude and duration of impoundment fluctuations. The PAD provides limited information on how project operations affect wetlands and the plant community composition within the project impoundment and downstream. Operations of the project must conform to Vermont goal of protecting significant wetlands and the values and function which they ensure that there is no net loss of such wetlands. The Agency requests a study to determine the impacted by normal daily and seasonal operations of the project on wetland communities.

Proposed Methodology
The widely accepted methodology in the Federal Manual for Identifying and Delineating Jurisdictional Wetlands, as amended and supplemental guidance documents issued by the U.S. Army Corps of Engineers is recommended for identifying wetlands. The Vermont classification system for natural communities should be used to classify community type (See Appendix A). The general community composition should be recorded as well as any rare, threaten or endangered plant species or invasive species. The proportion of wetlands that are impacted by project operations should be compared to reference wetlands communities to evaluate how plant species composition has been altered by project operations. The frequency, timing, amplitude, and duration of reservoir fluctuations on impacted wetlands and natural communities should be recorded throughout the year. The ratio of wetland types presently identified in the project boundaries should be compared to national wetland inventory maps to address if project operations have altered wetlands.

Level of Effort and Cost
The cost and effort of this study will be moderate, but is important to document the potential impact operations have on wetlands within the vicinity of the project to determine if Vermont's wetland management goals are being met.

Bellows Falls Hydroelectric Project – FERC No. 1855-045

Study Request 25: Impact of impoundment water level fluctuations on wetlands

Goals and Objectives
The goal of this study is to determine the impacts to wetlands from daily and seasonal water level fluctuation in the impoundment and downstream from the Bellows Falls Hydroelectric Project to the head of the Vernon impoundment.

The objectives of this study are to:
1. Identify all wetlands types, natural communities, and invasive species within the impoundment and downstream, and determine the proportion of wetlands and wetland type (i.e. emergent, shrub, forested) that are impacted by daily and seasonal water level fluctuations from project operations.
2. Determine the ratios of wetland types in the project area should be compared to previous national wetland inventory maps, and/or to reference conditions to determine if wetland types or natural communities within the project impoundment or downstream are being altered by project operations.
3. Determine how project operations are affecting the wetland plant community composition, including promoting the spread of invasive species or affecting rare, threaten, and endangered species.

Resource Management Goals
The Agency's goals related to aquatic natural resources are to:
1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

The goal of the Vermont Agency of Natural Resources is to identify and protect significant wetlands and the values and function which they ensure that there is no net loss of such wetlands and their function are achieved. Vermont classifies wetlands that are adjacent to streams, rivers, and open water that contain woody or persistent non-woody vegetation as Class II significant wetlands.

Public Interest Consideration
The requestor is a state natural resource agency.

Existing Information
The PAD does not address how wetlands type or wetland community composition that could be impacted by daily and seasonal water level fluctuations within the impoundment.

Project Nexus
The project impoundment extends 26 miles upstream from the dam. The project currently operates in a peaking mode, with allowable impoundment fluctuations of up to 3 feet, with proposals to continue as such. Wetlands can be affected by the operations of the hydropower project depending on frequency, timing, amplitude and duration of impoundment fluctuations. The PAD provides limited information on how project operations affect wetlands and the plant community composition within the project impoundment and downstream. Operations of the project must conform to Vermont goal of protecting significant wetlands and the values and function which they ensure that there is no net loss of such wetlands. The Agency requests a study to determine the impacted by normal daily and seasonal operations of the project on wetland communities.

Proposed Methodology
The widely accepted methodology in the Federal Manual for Identifying and Delineating Jurisdictional Wetlands, as amended and supplemental guidance documents issued by the U.S. Army Corps of Engineers is recommended for identifying wetlands. The Vermont classification system for natural communities should be used to classify community type (See Appendix A). The general community composition should be recorded as well as any rare, threaten or endangered plant species or invasive species. The proportion of wetlands that are impacted by project operations should be compared to reference wetlands communities to evaluate how plant species composition has been altered by project operations. The frequency, timing, amplitude, and duration of reservoir fluctuations on impacted wetlands and natural communities should be recorded throughout the year. The ratio of wetland types presently identified in the project boundaries should be compared to national wetland inventory maps to address if project operations have altered wetlands.

Level of Effort and Cost
The cost and effort of this study will be moderate, but is important to document the potential impact operations have on wetlands within the vicinity of the project to determine if Vermont's wetland management goals are being met.

Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 25: Impact of impoundment water level fluctuations on wetlands

Goals and Objectives

The goal of this study is to determine the impacts to wetlands from daily and seasonal water level fluctuation in the impoundment and downstream from the Vernon Hydroelectric Project to the head of the Turner Falls impoundment.

The objectives of this study are to:

1. Identify all wetlands types, natural communities, and invasive species within the impoundment and downstream, and determine the proportion of wetlands and wetland type (i.e. emergent, shrub, forested) that are impacted by daily and seasonal water level fluctuations from project operations.
2. Determine the ratios of wetland types in the project area should be compared to previous national wetland inventory maps, and/or to reference conditions to determine if wetland types or natural communities within the project impoundment or downstream are being altered by project operations.
3. Determine how project operations are affecting the wetland plant community composition, including promoting the spread of invasive species or affecting rare, threaten, and endangered species.

Resource Management Goals

The Agency's goals related to aquatic natural resources are to:

1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.
4.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

The goal of the Vermont Agency of Natural Resources is to identify and protect significant wetlands and the values and function which they ensure that there is no net loss of such wetlands and their function are achieved. Vermont classifies wetlands that are adjacent to streams, rivers, and open water that contain woody or persistent non-woody vegetation as Class II significant wetlands.

Public Interest Consideration
The requestor is a state natural resource agency.

Existing Information
The PAD does not address how wetlands type or wetland community composition that could be impacted by daily and seasonal water level fluctuations within the impoundment.

Project Nexus
The project impoundment extends 26 miles upstream from the dam. The project currently operates in a peaking mode, with allowable impoundment fluctuations of up to 8 feet, with proposals to continue as such. Wetlands can be affected by the operations of the hydropower project depending on frequency, timing, amplitude and duration of impoundment fluctuations. The PAD provides limited information on how project operations affect wetlands and the plant community composition within the project impoundment and downstream. Operations of the project must conform to Vermont goal of protecting significant wetlands and the values and function which they ensure that there is no net loss of such wetlands. The Agency requests a study to determine the impacted by normal daily and seasonal operations of the project on wetland communities.

Proposed Methodology
The widely accepted methodology in the Federal Manual for Identifying and Delineating Jurisdictional Wetlands, as amended and supplemental guidance documents issued by the U.S. Army Corps of Engineers is recommended for identifying wetlands. The Vermont classification system for natural communities should be used to classify community type (See Appendix A). The general community composition should be recorded as well as any rare, threaten or endangered plant species or invasive species. The proportion of wetlands that are impacted by project operations should be compared to reference wetlands communities to evaluate how plant species composition has been altered by project operations. The frequency, timing, amplitude, and duration of reservoir fluctuations on impacted wetlands and natural communities should be recorded throughout the year. The ratio of wetland types presently identified in the project boundaries should be compared to national wetland inventory maps to address if project operations have altered wetlands.

Level of Effort and Cost
The cost and effort of this study will be moderate, but is important to document the potential impact operations have on wetlands within the vicinity of the project to determine if Vermont's wetland management goals are being met.

Wilder Hydroelectric Project – FERC No. 1892-026
Bellows Falls Hydroelectric Project – FERC No. 1855-045
Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 26: Impacts of water level fluctuations on aquatic vegetation, including invasive species, in project impoundments

Goals and Objectives

The goal of this study is to determine if the full range of water level fluctuations from the Vernon, Bellows Falls and Wilder Hydroelectric Projects negatively impact emergent aquatic vegetation (EAV) and submerged aquatic vegetation (SAV) and their habitats in the impoundments and riverine reaches below the dams.

The objective is to conduct field studies in mainstem littoral zones, tributaries and backwaters to determine if EAV and SAV species distribution and abundance, and their habitats, are impacted by current water level fluctuations permitted under the TransCanada Projects' licenses and whether aquatic vegetation and its habitats can be enhanced by modifications to project operations or other mitigation measures and whether there is any unique or important shoreline or aquatic habitats that should be protected. Results of this study may also be used to help determine the adequacy of existing downstream minimum flow requirements.

The specific objectives of the field study, at a minimum, include:

- Quantitatively describe and map wetland types within 200 feet of the shoreline, and describe associated wildlife;
- Delineate, quantitatively describe, and map all wetland types including invasive species and wildlife observed (e.g., bald eagle nesting, water fowl nesting) within 200 feet of the shoreline, and the extent of this habitat if it extends beyond 200 feet; and
- Quantitatively describe (e.g., substrate composition, vegetation type and abundance) and map shallow water aquatic habitat types subject to project operation inundation and exposure, noting and describing additional areas where water depths at lowest operational range are wetted to a depth less than one foot (flats, near shore areas, gravel bars, with very slight bathymetric change);

A second year of study may be required should river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

The field study should produce a habitat inventory report that includes:

- The results of the field study in the form of maps and descriptions;
- An assessment of project effects on wetland, riparian, littoral zone vegetation and shallow water habitats, invasive plant species, and wildlife habitat at the project; and
- Recommendations for any necessary plant, habitat type, or wildlife, protection and/or invasive species control measures.

Resource Management Goals

The Agency's goals related to aquatic natural resources are to:

1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Vermont Fish and Wildlife Department's Strategic Plan (2002 -2010) focuses towards four major areas of concern: resource conservation, fish and wildlife-based recreation and use, human health and safety, efficient operations, and effective management.

Riverine fish species are an important component of the river's ecology and in some cases are the basis for a sport fishery. Aquatic vegetation is crucial fish habitat as the majority of fish in the project impoundments utilize EAV and SAV at some point during their life history. This requested study will help enhance EAV and SAV in the project impoundments.

Public Interest Consideration

The New Hampshire Fish and Game Department, the Vermont Fish and Wildlife Department, and the New Hampshire Department of Environmental Services are requesting this study. The requestors are state natural resource agencies.

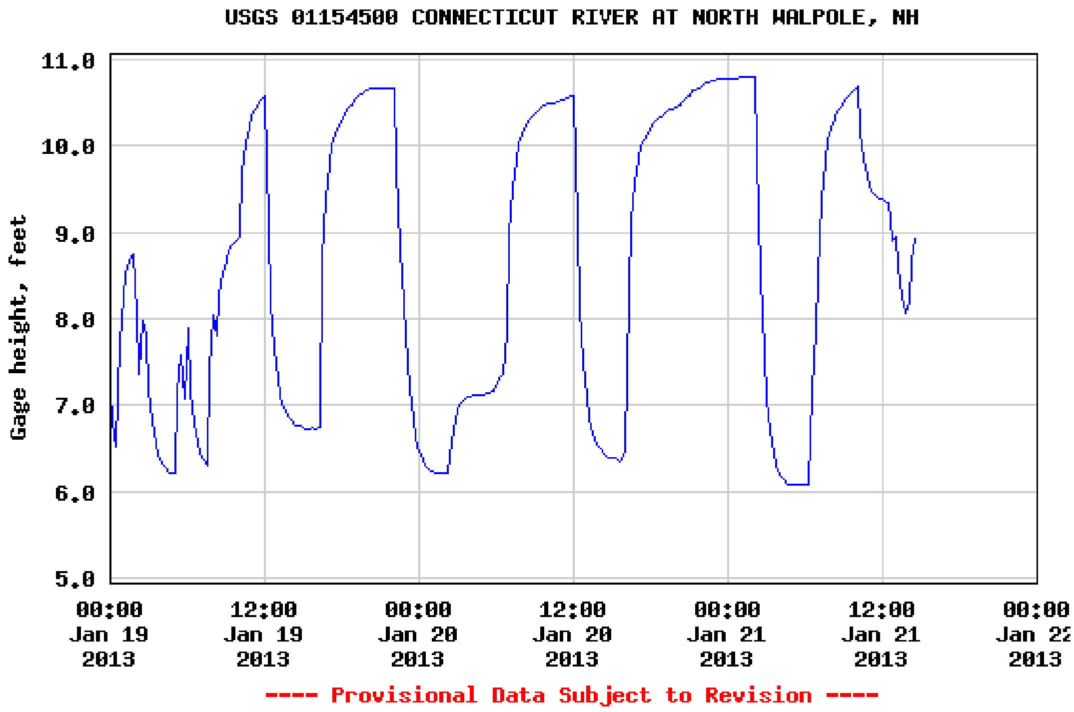
Existing Information

Existing information in the PADs does not quantify EAV and SAV. However, the applicant acknowledges that water level fluctuations caused by the project have the potential to affect fringing wetland and littoral areas:

> "*The average daily water level fluctuation of 2.5 vertical feet has resulted in a zone of sparse vegetation along most of the shorelines of the impoundment. Wetland and littoral resources in this zone are limited by the frequent wetting and drying*." (Wilder PAD, p.3-

104, see also similar language in the Bellows Falls PAD p. 3-115 and the Vernon PAD p. 3-143)

An example of the water level fluctuations that occur in the Lower Connecticut River due to hydropower generation is shown below.



Project Nexus

Water level fluctuations due to project operations have the potential to influence fish species life history requirements, biological interactions, and habitat quantity and quality by impacting EAV and SAV. For example, water level changes due to project operations could create conditions where EAV and SAV abundance is diminished, thus negatively impacting a habitat used by riverine fish for spawning, rearing, feeding, and cover. Additionally, water level fluctuations due to project operations could influence EAV and SAV habitat in the project impoundments and promote invasive plants over native species. This study needs to take into account existing and potential future limits on impoundment level fluctuations intended to limit recreation impacts, and the interactions of any changes in pond level fluctuation range or frequency and discharge changes.

Proposed Methodology

Vegetation mapping and mapping of littoral zones in relation to water level fluctuations are common tools for identifying EAV and SAV that may be impacted by changes in water levels. The study should include field surveys designed to describe the characteristics of each mapped wetland, riparian, littoral and shallow water habitat including plant species composition, relative abundance/density, habitat quality, and land use. These surveys should be conducted to describe these habitats at the lowest water level operational range permitted on a daily operation schedule, under low flow conditions. Information collected should include:

- Plant species composition, and their relative abundance/density and condition/structure (e.g., seedlings)
- Surveying for the federally Endangered Northeastern bulrush (*Scirpus ancistrochaetus*);
- Structured data, including estimates of average heights and aerial cover of each vegetation layer (specifically denoting invasive species);
- Aquatic habitat substrate composition, quantity (i.e., percent types and area), wood structure (relative abundance measure applied by area), water depths (inundated, exposed, and water less than one foot);
- Predominate land use(s) associated with each cover type;
- Wildlife sightings should be noted;
- Field verified wetland, riparian, and littoral and shallow water habitats and invasive species occurrences, should be geo-referenced as polygons and overlain on orthophoto at a suitable scale.

Bathymetric mapping of the littoral zone will be needed to model the extent of this zone that will be affected by different water fluctuation scenarios.

The study area is from the most upstream area influenced by the Wilder Dam to the most downstream area influenced by the Vernon Dam. Water level fluctuations caused by the projects may affect not only the impoundments, but also the downstream river reaches below the dams. Studies would occur in the main river littoral zone and in backwater areas during spring, summer and fall. A second year of study may be required if first year data collection is limited due to environmental or other conditions, or if river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

Level of Effort and Cost

Although the PAD's acknowledge that project operations have the potential to impact littoral resources, TransCanada did not propose any studies concerning aquatic vegetation. Analysis as described above is needed to understand potential impacts of the projects on these resources. Estimated cost for the study is moderate due to the need for field assessment.

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Vermont Fish and Wildlife Department . 2006. Vermont Fish and Wildlife Strategic Plan. http://www.vtfishandwildlife.com/library/reports_and_documents/Fish_and_wildlife/Strategic_Plan.pdf

Turners Falls Hydroelectric Project – FERC No. 1889-081
Northfield Mountain Pumped Storage Project – FERC No. 2485-063

Study Request 26: Impacts of water level fluctuations on aquatic vegetation, including invasive species, in project impoundment

Goals and Objectives

The goal of this study is to obtain baseline information on riparian, wetland, Emergent Aquatic Vegetation (EAV), Submerged Aquatic Vegetation (SAV), littoral zone and shallow water aquatic habitats (subject to operational inundation and exposure to near exposure) known to occur in the project area. Information would be used to determine whether riparian, wetland, EAV and SAV, littoral, and shallow water (e.g., mid river bars and shoals) habitats are impacted by current water level fluctuations permitted under the Turners Falls and Northfield projects' licenses and whether these vegetation types and shallow water habitats can be protected and restored by modifications to project operations or other mitigation measures. This analysis needs to take into account existing and potential future limits on pond level fluctuations intended to limit recreation impacts, and the interactions of any changes in pond level fluctuation range or frequency and discharge changes under a new licenses of the Turners Falls and upstream projects. This information is needed to determine whether the projects operation affects plants, habitat, and wildlife in the project area, whether aquatic vegetation and its habitats can be enhanced by modifications to project operations or other mitigative measures, and whether there is any unique or important shoreline or aquatic habitats that should be protected.

The specific objectives of the field study, at a minimum, include:

- Quantitatively describe and map wetland types within 200 feet of the shoreline, and describe associated wildlife;
- Delineate, quantitatively describe, and map all wetland types including invasive species and wildlife observed (e.g., bald eagle nesting, water fowl nesting) within 200 feet of the shoreline, and the extent of this habitat if it extends beyond 200 feet; and
- Quantitatively describe (e.g., substrate composition, vegetation type and abundance) and map shallow water aquatic habitat types subject to project operation inundation and exposure, noting and describing additional areas where water depths at lowest operational range are wetted to a depth less than one foot (flats, near shore areas, gravel bars, with very slight bathymetric change);

A second year of study may be required should river discharge in the first year prove to be atypical (outside of 25-75th percentile of average weekly flow values) during the study period.

The field study should produce a habitat inventory report that includes:

- The results of the field study in the form of maps and descriptions;
- An assessment of project effects on wetland, riparian, littoral zone vegetation and shallow water habitats, invasive plant species, and wildlife habitat at the project; and
- Recommendations for any necessary plant, habitat type, or wildlife, protection and/or invasive species control measures.

Resource Management Goals

The Agency's goals related to aquatic natural resources are to:

1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Vermont Fish and Wildlife Department's Strategic Plan (2002 -2010) focuses towards four major areas of concern: resource conservation, fish and wildlife-based recreation and use, human health and safety, efficient operations, and effective management. The Agency aims to protect and restore native riparian, wetland, EAV, SAV, littoral and shallow water habitat (i.e., spawning and or nursery areas for aquatic organisms) in the project reservoir.

Public Interest Consideration

The requestor is a resource agency.

Existing Information

Existing information in the PAD does not quantify EAV and SAV in this area, or other shallow aquatic habitat types and physical features (e.g., depths, substrates, wood structure) that are the environment for aquatic biota in the project area. The PAD does provide some limited monitoring data for 2012 (2 locations) on water surface elevations that show daily fluctuations, in the upper third of this impoundment, that varied over 4 feet on a daily cycling frequency, with fluctuations generally in the 2 foot range in low flow months for the data provided in the PAD. The current license does permit a greater pool elevation operational fluctuation, up to a 9 foot change in elevation, based on the Turners Falls Dam water elevation. In the PAD it is noted these operational fluctuations under most circumstances at the Turners Falls Dam are within 3.5 feet.

In the PAD it is noted that FLP would like to expand its NMPS upper reservoir capacity (by up to 24%), how this may affect project operations and the habitats noted in this request is unknown. It is also noted that water is typically pumped to the upper reservoir in evening and generation back to the river occurs once to twice daily, in daytime hours, based upon power needs and power value. Under current license conditions, provided set thresholds for minimum flow and Turners Dam current license elevations are met, the NMPS may operate with no restriction in timing, frequency, or magnitude for pumping or generation. No data were provided on the operation of the NMPS plant over time relative to data on pumping and generation on an hourly basis, averaged values were provided over monthly periods. It is unclear what the actual timing, frequency and magnitude of these NMPS operations are over the course of a year and how that relates to; aquatic plant species establishment, growth, survival, littoral zone or other shallow water habitat fish spawning periods and their effects on these fishes (reproduction success and subsequent recruitment, e.g., bass and fall fish nests) in available and utilized habitat, and how the quantity and quality of these shallow water habitats are effected by project operational manipulation/alteration, as currently permitted or proposed.

The PAD provides lists of plant and wildlife species whose native ranges overlap with the project area, but it does not provide any baseline information on known occurrences of these species in the wetlands, riparian, littoral and shallow water habitats, within or adjacent to, the project area. Plant and wildlife occurring in these habitats may benefit from protection, mitigation, and enhancement (PMEs) measures, given the potential effects of continuing the current semiautomatic peaking operating regime. In addition, a large scale sediment discharge from NMPS resulted in regulatory actions by FERC, the EPA and MADEP in 2010. Continuing and as yet unresolved management plan measures relative to sediment and NMPS project operations, are further concerns for shallow water, littoral zone, and wetland habitats.

The Atlantic States Marine Fisheries Commission, Atlantic Coast Diadromous Fish Habitat: A Review of utilization, threats, recommendations for conservation, and research needs (ASMFC 2009), contains a review of habitat information for these species. Recommendations in this report include: Maintain water quality and suitable habitat for all life stages of diadromous species in all rivers with populations of diadromous species.

Project Nexus

Water level fluctuations due to project operations could affect EAV and SAV habitat as well as the quantity and quality littoral and shallow water habitat. These operational water level fluctuation effects are expected to impact fish species use of these habitats and may affect spawning fishes reproductive success and subsequent population recruitment including but not limited to American shad, blueback herring, sea lamprey, fall fish, and bluegill, which spawn in mid to late spring through early summer in areas subject to daily or more frequent water level fluctuations.

The current operating mode, as well as the unknowns with proposed upper reservoir expansion, may affect wetland riparian, littoral and other shallow water habitats and promote the introduction and expansion of invasive plant species through fluctuating water levels. A study that explains the relationship between the proposed mode of operation and the type and quantity or wetland, riparian, littoral, shallow water habitats, and invasive species affected would help inform a decision on the need for protection and/or control of these resources in the license.

Proposed Methodology

The PAD currently contains maps portraying general wetland types from the Cabot Station tailrace upstream to the Vernon Dam. In addition, the Service understands that the detailed bathymetry exists for the Turners Falls impoundment. The proposed study should utilize this existing information in conjunction with field surveys designed to describe the characteristics of each mapped wetland, riparian, littoral and shallow water habitat including plant species composition, relative abundance/density, habitat quality, and land use. These surveys should be conducted to describe these habitats at the lowest water level operational range permitted on a daily operation schedule, under low flow conditions. Information collected should include:

- Plant species composition, and their relative abundance/density and condition/structure (e.g., seedlings);
- Structured data, including estimates of average heights and aerial cover of each vegetation layer (specifically denoting invasive species);
- Aquatic habitat substrate composition, quantity (i.e., percent types and area), wood structure (relative abundance measure applied by area), water depths (inundated, exposed, and water less than one foot);
- Predominate land use(s) associated with each cover type;
- Wildlife sightings should be noted;
- Field verified wetland, riparian, and littoral and shallow water habitats and invasive species occurrences, should be geo-referenced as polygons and overlain on orthophoto at a suitable scale.

Level of Effort and Cost

In the PAD, First Light identified impacts of the project operations on wetlands, riparian and littoral zone habitat as a potential issue to be addressed in relicensing, and proposed wetland vegetation mapping. However, additional analysis as described above is needed to understand the impacts of the project on these resources and habitats.

A wetlands, riparian, littoral/shallow water, invasive species inventory, of the scope envisioned, would likely require 6-8 months to complete and cost $40,000 to $50,000.

Literature Cited

Atlantic States Marine Fisheries Commission. 2009. Atlantic coast diadromous fish habitat: A review of utilization, threats, recommendations, for conservation, and research needs. Habitat Management Series #9. Washington, D.C.

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Wilder Hydroelectric Project – FERC No. 1892-026
Bellows Falls Hydroelectric Project – FERC No. 1855-045

Study Request 27: Project effects on the dwarf wedgemussel (**Alasmidonta heterodon*****)***

Goals and Objectives

It has been well documented that the damming of rivers can have detrimental impacts on the mussel communities that inhabit areas both upstream and downstream of dams (Watters 1999, Layzer et. al. 1993, Moog 1993). The goal of this study is to evaluate the effects that the Wilder, and Bellows Falls hydroelectric projects have on populations of the federally-endangered dwarf wedgemussel (*Alasmidonta heterodon*). In addition, the results of the study can be used to develop measures to minimize adverse impacts to the dwarf wedgemussel in the future.

The specific objectives of the study are as follows:

1. Conduct an initial survey of the free flowing stretch of the Connecticut River from the Wilder Dam to the upstream end of the Bellows Falls impoundment to determine the distribution of the dwarf wedgemussel in this reach.
2. Determine the best sites for intensive quantitative sampling of mussel communities, with emphasis on the dwarf wedgemussel. Data will be collected to estimate density (mussels per unit area) and age class structure for all species.
3. Lay the groundwork for a long-term monitoring program.
4. Document instream behavior of mussels during varying flow conditions.
5. Determine how availability and persistence of dwarf wedgemussel habitat changes with water level and flow fluctuations.

Resource Management Goals

The dwarf wedgemussel is a federally- and state-endangered species. As such, this study request is intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures and protection, mitigation, and enhancement measures for the species pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq*.), and Vermont's Endangered Species Law (10 V.S.A. section 5401 et. seq.).

The Agency of Natural Resources conservation goals for endangered species are:

1. Maintain or increase populations of rare, threatened, and endangered species in the town or area of interest.
2. Maintain, restore, provide stewardship for, and conserve habitats and natural communities that support rare, threatened, and endangered species.

The Connecticut River dwarf wedgemussel population is one that must be demonstrated to be viable in order before the species can be down listed to threaten. The Upper Connecticut metapopulation is likely the largest remaining population in the world (USFWS 2007), and so its protection is essential to the recovery of the species as a whole.

Public Interest Consideration
The requestor is a state natural resource agency

Existing Information
In 2011, Biodrawversity, LLC conducted a freshwater mussel survey throughout the Vernon, Bellows Falls, and Wilder project areas (Biodrawversity and LBG 2012). This survey was semi-quantitative (i.e. timed searches were used) and the main goal was to assess the distribution, abundance, demographics, and habitat of the dwarf wedgemussel in the project areas. Dwarf wedgemussel were found in the Wilder impoundment (all within a 14-mile stretch of the river beginning 27 miles upstream of the Wilder Dam) and Bellows Falls impoundment (located sporadically in the upper 17 miles of the impoundment); none were found in the Vernon project-affected area. These results corroborate the results of other studies performed in the past in these areas (Nedeau 2006a, Nedeau 2006b).

The 2011 survey did not include the 17-mile free flowing stretch of the Connecticut River downstream of Wilder Dam. The dwarf wedgemussel has, in the past, been found within this river reach, although overall there has been limited survey work in the area. A better understanding of the distribution and abundance of the dwarf wedgemussel in this stretch of the river is required before an evaluation of how the dam affects this species can be made. **This need is represented in Objective 1**.

Since the 2011 survey was semi-quantitative, it cannot be used as a basis for determining population estimates or trends (Wicklow 2005). In fact, few if any of the past surveys performed in the project-affected areas have employed quantitative methodology. In addition, there is little quantitative information regarding the age class structure, and therefore recruitment, of the mussel communities in the area. In order to demonstrate that a dwarf wedgemussel population is viable according to the Dwarf Wedgemussel Recovery Plan (USFWS 1993), it must have a large and dense enough population to maintain genetic variability and annual recruitment must be adequate to maintain a stable population. Thus, knowledge of population size and density as well as a better understanding of age class structure is a necessary step in determining the baseline status of dwarf wedgemussel populations. The 2011 survey and other surveys can be used to determine the best sites for implementing a monitoring program. **This need is represented in Objective 2**.

Once this baseline is established, it will be important to monitor the sites so that biologists can estimate and track changes to dwarf wedgemussel populations and/or evaluate any project-related population impacts. Therefore, there is a need to develop long-term monitoring plots that will be surveyed at regular intervals using methodology that is repeatable and yields quantitative, statistically valid results. **This need is represented in Objective 3**.

Flow conditions that result from dam operations may alter the behavior of individual dwarf wedgemussels or individuals of other species. Dam operations affect streamflow, temperature, and dissolved oxygen, and changes to these variables can often be rapid. It is not known how these rapid changes affect various aspects of a mussel’s biology, including lure display, shell position (open/closed), siphoning rate, and vertical migration. **This need is represented in Objective 4**.

Dam operations can also affect the availability of habitat for mussels, and this availability can change quickly as water levels fluctuate under peaking operations. The persistence of habitat is a key element to the long-term success of sedentary lotic organisms such as the dwarf wedgemussel (Maloney et. al. 2012), which is unable to quickly move in response to rapid changes in its environment and can thus become stranded in areas of unsuitable habitat; however, there is currently no information concerning the relation of project operations to habitat persistence within the Wilder and Bellows project-affected areas. **This need is represented in Objective 5**.

Project Nexus

The dwarf wedgemussel is known to occur within the Wilder and Bellows Falls project areas and operations of these two dams may affect the viability of this species in the Connecticut River. This study plan will allow for a better understanding of how sub-daily flow and water level fluctuations influence dwarf wedgemussel abundance, available habitat, and behavior. This information can be used to inform the development of license requirements that can ensure the continued existence of this species within the project-affected areas.

Additionally, a long-term monitoring program of important dwarf wedgemussel sites within the project areas is necessary to evaluate any project-related population and/or behavioral impacts that may occur. This information can be used to inform decision makers in the future.

Proposed Methodology

A survey of the 17-mile reach between the Bellows Falls impoundment and the Wilder Dam is the logical first step of the study plan, and this can be done in well less than one field season. This may be treated as an extension of the Biodrawversity and LBG (2012) survey and the same semi-quantitative methodology may be used. Once completed, this survey will help fill in the knowledge gap that exists in the distribution of the dwarf wedgemussel within this reach of the Connecticut River. **This proposed methodology corresponds to Objective 1**.

Next, quantitative study plots should be established at sites throughout the two project-affected areas that are known to support the dwarf wedgemussel. Plots should be set up and surveyed using methodology that will allow for the estimation of population density and size. Smith et. al. (2001) have developed such a methodology, which is also outlined in Strayer and Smith (2003). It is based on a double-sampling design (visual inspection of the substrate surface plus excavation of a random subset of quadrats) using 0.25 m^2 quadrats that are placed systematically with multiple random starts. This protocol has been used to monitor dwarf wedgemussel populations at two sites on the Ashuelot River in Keene, NH (Nedeau 2004). A number of other recent studies have also made use of this protocol for different species of mussels (Fulton et. al. 2010, Crabtree & Smith 2009, Bradburn 2009).

Data to determine age class structure should also be collected at these selected sites. This would involve measuring the length and estimating the age (through external annuli counts) of each mussel sampled within a quadrat. Based on this information, an analysis of recruitment can be made. This field work and analysis was performed on the mussel community inhabiting the lower Osage River in Missouri as part of the relicensing process of the Osage Hydroelectric

Project (FERC no. 459) (ESI 2003). The work done on the Osage can be used as a template for this study. Depending on how many plots are chosen, this phase of the study could take one or two field seasons. **This proposed methodology corresponds to Objective 2**.

The sites surveyed to meet Objective 2 should be resurveyed using the same methodology at regular intervals in the future so that any changes over time and/or over varied flow regimes can be evaluated. In addition, a mark-recapture pilot study should be initiated to evaluate the potential for using this methodology for long-term monitoring of dwarf wedgemussel abundance and survival. Mark-recapture methods provide statistically robust estimates of population parameters that are superior to simple count estimates in cases where it is not practicable to count all individuals in a population. Methods should be similar to those in Peterson et al. (2011), Meador et al. (2011), and Villella et al. (2004), but should focus on differences among sampled sites. Sites should be selected based on those sampled to meet Objective 2, but should also include sites outside of the project area to fully evaluate project effect and to account for any natural variability that may be independent of project effect.

A long-term mussel monitoring program was devised as part of the study plan for the relicensing of the Lake Blackshear Hydroelectric Project (FERC no. 659) on the Flint River in Georgia. According to the monitoring plan (Lake Blackshear Project 2009), three surveys will be conducted five years apart, beginning five years after issuance of the FERC license. Surveys will be quantitative (there is a qualitative aspect to the Lake Blackshear mussel monitoring plan that can be ignored) and will focus on evaluating changes in recruitment and population size of the purple bankclimber (*Elliptoideus sloatianus*), a federally-listed species. A similar protocol should be used to monitor dwarf wedgemussel populations in the project-affected areas of the Connecticut River post-license, although the number of surveys and the time between surveys may require some research and discussion. **This proposed methodology corresponds to Objective 3**.

In order to investigate the effects that the hydropower projects have on mussel behavior, individual mussels should be observed as flow fluctuates as a result of dam operations. Researchers should measure changes in shell position (open/closed), siphoning rate, lure display, horizontal migration (movement across the substrate), and vertical migration (burrowing). Past studies have quantified changes in vertical migration due to flow fluctuations (Saha & Layzer 2008, DiMaio & Corkum 1997). This phase of the study will likely take two field seasons in order to maximize the number of behavioral observations so that any trends can be identified and evaluated. **This proposed methodology corresponds to Objective 4**.

At these same sites, an evaluation of flow fluctuations on dwarf wedgemussel habitat persistence should be conducted following methods similar to those of Maloney et. al. (2012). This will include the development of a two-dimensional hydrodynamic model based on modeled depth, velocity, Froude number, shear velocity, and shear stress. This model will be used to quantify suitable dwarf wedgemussel habitat and its persistence over a range of flows, including flows typically experienced under peaking operations. These methods are being employed to evaluate persistence of dwarf wedgemussel habitat on the Delaware (Maloney et. al. 2012) and Susquehanna (T. Moburg, The Nature Conservancy, personal communication) rivers. Depending on how many plots are chosen, this phase of the study could take one or two field seasons. **This proposed methodology corresponds to Objective 5**.

Level of Effort and Cost

The cost for collecting the data for this study is entirely dependent on the number of study sites selected, as well as how frequently surveys will be conducted as part of the long-term monitoring plan. The expected level of effort and anticipated costs will be comparable to that of similar FERC relicensing projects of this size.

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Wilder Hydroelectric Project – FERC No. 1892-026

Study Request 28: Assess the impact of project operations on state-listed rare, threatened and endangered plant species and significant natural communities

Goals and Objectives
The goal of this study is to determine the potential impact of water fluctuations downstream and within the impoundment from project operations on state listed rare, threaten, and endangered plant species (S1 & S2) and significant natural communities. The survey should encompass all areas from the head of the impoundment, downstream to the start of the next projects impoundment.

The objectives of this study are:
- Identify rare and state listed plants and significant natural communities that might be affected by an altered hydrological regime.
- Determine mitigation in operations that might be appropriate to ameliorate any adverse impacts.

Resource Management Goals
Vermont threatened and endangered species are protected by Vermont's Endangered Species Law (10 V.S.A. section 5401 et. seq.). The Agency of Natural Resources conservation goals for endangered species are:
1. Maintain or increase populations of rare, threatened, and endangered species in the town or area of interest.
2. Maintain, restore, provide stewardship for, and conserve habitats and natural communities that support rare, threatened, and endangered species.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the Vermont Fish and Wildlife Department mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:
1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Public Interest Consideration
The requestor is a state natural resource agency.

Existing Information
The PAD indicates that there are many state listed rare, threaten, and endangered plant species occur within project area. A rare plant and community survey was conducted in summer 2012 to document the presence or absence of rare species, identify additional locations of rare species, and to evaluate the potential for project impacts on rare species. The PAD indicates that the detailed results of this survey would be available in late 2012, but at the time of filing this study request, the report was not available for Agency review to confirm the appropriate methodology was used and conclusions in the PAD.

Project Nexus
The project impoundment extends 45 miles upstream from the dam. The project currently operates in a peaking mode, with allowable impoundment fluctuations of up to 5 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (675 cfs), but can increase rapidly during times of power generation. Rare plants and natural communities can be affected by the operations of the hydropower project depending on frequency, timing, amplitude and duration of impoundment fluctuations. The PAD provides limited information on how project operations affect the rare plant communities' composition within the project impoundment. Operations of the project must conform to protect state listed plant species and natural communities. The Agency requests a study to determine the impacted by normal daily and seasonal operations of the project on state listed rare, threaten, and endangered plant species (S1 & S2) and significant natural communities.

Proposed Methodology
To assess the adverse impact of project operations on state listed plants and natural communities a survey of the impoundment and downstream of the project should be conducted. The survey should survey all that could potentially be affected by project operations. This survey should extend to cover the 100 year floodplain. A precise elevation should be recorded with a GPS unit to determine the proximity to project operations. An assessment of the plants and natural community overall health and condition should be determined to assess whether project operations are negatively impacting the community. State listed or natural communities deemed to be impacted by project operations; mitigation in operational procedures should be explored. Mitigation of the project operations on plants and natural communities should take into account the physical and biological requirements and whether there are certain times that the plants and/or community are more sensitive to project operations.

Level of Effort and Cost
The cost and effort of this study will be moderate, but is important to document the potential impact operations have on state listed plants and significant natural communities within the vicinity of the project to determine if Vermont's natural resource management goals are being met.

Bellows Falls Hydroelectric Project – FERC No. 1855-045

Study Request 28: Assess the impact of project operations on state-listed rare, threatened and endangered plant species and significant natural communities

Goals and Objectives

The goal of this study is to determine the potential impact of water fluctuations downstream and within the impoundment from project operations on state listed rare, threaten, and endangered plant species (S1 & S2) and significant natural communities. The survey should encompass all areas from the head of the impoundment, downstream to the start of the next projects impoundment.

The objectives of this study are:

- Identify rare and state listed plants and significant natural communities that might be affected by an altered hydrological regime.
- Determine mitigation in operations that might be appropriate to ameliorate any adverse impacts.

Resource Management Goals

Vermont threatened and endangered species are protected by Vermont's Endangered Species Law (10 V.S.A. section 5401 et. seq.). The Agency of Natural Resources conservation goals for endangered species are:

1. Maintain or increase populations of rare, threatened, and endangered species in the town or area of interest.
2. Maintain, restore, provide stewardship for, and conserve habitats and natural communities that support rare, threatened, and endangered species.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the Vermont Fish and Wildlife Department mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Public Interest Consideration

The requestor is a state natural resource agency.

Existing Information
The PAD indicates that there are many state listed rare, threaten, and endangered plant species occur within project area. A rare plant and community survey was conducted in summer 2012 to document the presence or absence of rare species, identify additional locations of rare species, and to evaluate the potential for project impacts on rare species. The PAD indicates that the detailed results of this survey would be available in late 2012, but at the time of filing this study request, the report was not available for Agency review to confirm the appropriate methodology was used and conclusions in the PAD.

Project Nexus
The project impoundment extends 26 miles upstream from the dam. The project currently operates in a peaking mode, with allowable impoundment fluctuations of up to 3 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1080 cfs), but can increase rapidly during times of power generation. Rare plants and natural communities can be affected by the operations of the hydropower project depending on frequency, timing, amplitude and duration of impoundment fluctuations. The PAD provides limited information on how project operations affect the rare plant communities' composition within the project impoundment. Operations of the project must conform to protect state listed plant species and natural communities. The Agency requests a study to determine the impacted by normal daily and seasonal operations of the project on state listed rare, threaten, and endangered plant species (S1 & S2) and significant natural communities.

Proposed Methodology
To assess the adverse impact of project operations on state listed plants and natural communities a survey of the impoundment and downstream of the project should be conducted. The survey should survey all that could potentially be affected by project operations. This survey should extend to cover the 100 year floodplain. A precise elevation should be recorded with a GPS unit to determine the proximity to project operations. An assessment of the plants and natural community overall health and condition should be determined to assess whether project operations are negatively impacting the community. State listed or natural communities deemed to be impacted by project operations; mitigation in operational procedures should be explored. Mitigation of the project operations on plants and natural communities should take into account the physical and biological requirements and whether there are certain times that the plants and/or community are more sensitive to project operations.

Level of Effort and Cost
The cost and effort of this study will be moderate, but is important to document the potential impact operations have on state listed plants and significant natural communities within the vicinity of the project to determine if Vermont's natural resource management goals are being met.

Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 28: Assess the impact of project operations on state-listed rare, threatened and endangered plant species and significant natural communities

Goals and Objectives
The goal of this study is to determine the potential impact of water fluctuations downstream and within the impoundment from project operations on state listed rare, threaten, and endangered plant species (S1 & S2) and significant natural communities. The survey should encompass all areas from the head of the impoundment, downstream to the start of the next projects impoundment.

The objectives of this study are:
- Identify rare and state listed plants and significant natural communities that might be affected by an altered hydrological regime.
- Determine mitigation in operations that might be appropriate to ameliorate any adverse impacts.

Resource Management Goals
Vermont threatened and endangered species are protected by Vermont's Endangered Species Law (10 V.S.A. section 5401 et. seq.). The Agency of Natural Resources conservation goals for endangered species are:
1. Maintain or increase populations of rare, threatened, and endangered species in the town or area of interest.
2. Maintain, restore, provide stewardship for, and conserve habitats and natural communities that support rare, threatened, and endangered species.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the Vermont Fish and Wildlife Department mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:
1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Public Interest Consideration
The requestor is a state natural resource agency.

Existing Information
The PAD indicates that there are many state listed rare, threaten, and endangered plant species occur within project area. A rare plant and community survey was conducted in summer 2012 to document the presence or absence of rare species, identify additional locations of rare species, and to evaluate the potential for project impacts on rare species. The PAD indicates that the detailed results of this survey would be available in late 2012, but at the time of filing this study request, the report was not available for Agency review to confirm the appropriate methodology was used and conclusions in the PAD.

Project Nexus
The project impoundment extends 26 miles upstream from the dam. The project currently operates in a peaking mode, with allowable impoundment fluctuations of up to 8 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1250 cfs), but can increase rapidly during times of power generation. Rare plants and natural communities can be affected by the operations of the hydropower project depending on frequency, timing, amplitude and duration of impoundment fluctuations. The PAD provides limited information on how project operations affect the rare plant communities' composition within the project impoundment. Operations of the project must conform to protect state listed plant species and natural communities. The Agency requests a study to determine the impacted by normal daily and seasonal operations of the project on state listed rare, threaten, and endangered plant species (S1 & S2) and significant natural communities.

Proposed Methodology
To assess the adverse impact of project operations on state listed plants and natural communities a survey of the impoundment and downstream of the project should be conducted. The survey should survey all that could potentially be affected by project operations. This survey should extend to cover the 100 year floodplain. A precise elevation should be recorded with a GPS unit to determine the proximity to project operations. An assessment of the plants and natural community overall health and condition should be determined to assess whether project operations are negatively impacting the community. State listed or natural communities deemed to be impacted by project operations; mitigation in operational procedures should be explored. Mitigation of the project operations on plants and natural communities should take into account the physical and biological requirements and whether there are certain times that the plants and/or community are more sensitive to project operations.

Level of Effort and Cost
The cost and effort of this study will be moderate, but is important to document the potential impact operations have on state listed plants and significant natural communities within the vicinity of the project to determine if Vermont's natural resource management goals are being met.

Wilder Hydroelectric Project – FERC No. 1892-026
Bellows Falls Hydroelectric Project – FERC No. 1855-045
Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 29: Survey the number, species and behavior of adult dragonflies and emerging nymphs within the project areas

Goals and Objectives

The goal of this study is to conduct an inventory to detect and gather information on known and new odonate populations classified as Species of Greatest Conservation Need (SGCN) along the Connecticut River throughout the project area to assess the potential impact of project operations on dragonflies species habitat and survival.

The objectives of this study are:

Obtain information on the habitats of each species collected, in particular the riparian zone vegetation cover, river substrate and water quality.

Obtain information on the life cycle of each species present and most importantly, the hatching period and number per year of nymphs.

Obtain baseline distributional and relative abundance data for all odonate species by conducting surveys throughout the project areas.

Assess the vulnerability of nymphs of each species to disturbances such as water level fluctuation during nymph hatching, flow fluctuations, changes in vegetation or exposed hard substrate in the riparian area.

Determine if Project operations are adversely affecting the survival success of emerging nymphs (i.e. if flow alterations are causing mortality prior to hardening off).

If it is determined that the Project operations are adversely affecting survival, identify operational regimes that will reduce and minimize impacts odonates and odonate habitat within the project area.

Resource Management Goals

The Agency's goals related to aquatic natural resources are to:

1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by Project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.

2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Three odonate species within the lower Connecticut River drainage are listed as Vermont Species of Greatest Conservation Need (SGCN) within the River/Stream odonates group.

Conversion of habitat, habitat alteration and sedimentation are all identified in the Vermont Wildlife Action Plan (VWAP) as current problems facing odonates.

A high priority strategy in the VWAP for odonate management is the acquisition or easements on high priority SGCN odonate riverine sites.

Protecting and restoring aquatic and riparian habitats through improved water quality; flow, water level and temperature regimes; sediment reduction; establishment of streamside buffers; and suitable aquatic habitat structure, diversity and complexity is a conservation strategy identified in the VWAP for aquatic species.

Results of the survey will be used to develop flow-related license requirements and/or other mitigation measures that will optimize habitat for these Vermont SGCN.

Public Interest Consideration

The requestor is a state resource agency.

Existing Information

At least nine odonate species are known to inhabit the Connecticut River valley in Vermont, the habitat requirements of which vary within the general rivers/streams category. Most species have not been assigned state status ranks, due to incomplete distribution and abundance information.[2]

A total of 18 dragonfly species have been documented in the Connecticut River valley in Massachusetts just south of the Vernon project area, including 8 that are listed by the state of Massachusetts as Species of Special Concern, Threatened, or Endangered, including some known Vermont species. [1]. However, their existence above the Vernon dam is unknown.

Odonates emerge from the water as nymphs and shed their pupal skins at or very close to the first vertical surface they encounter. Dragonflies are soft for the first half-hour after emerging from their skins and are at risk of being injured or killed by waves from passing boats and rapidly fluctuating water levels. Until their bodies harden and their wings dry, they cannot move further up the bank. Dragonflies that emerge at or very close to the waterline are therefore at significantly higher risk of injury or death. [1]

To date no studies have been conducted above the Vernon Dam to identify odonate populations within the three project areas and whether project operations are affecting these populations.

Project Nexus

The Wilder Project impounds 45 miles of river that would otherwise be free flowing. The project currently operates in a peaking mode, with allowable impoundment fluctuations of up to 5 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (675 cfs), but can increase rapidly during times of power generation.

The Bellows Falls Project impounds 26 miles of river that would otherwise be free flowing. The project currently operates in a peaking mode, with allowable impoundment fluctuations of up to 3 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1083 cfs), but can increase rapidly during times of power generation.

The Vernon Project impounds 26 miles of river that would otherwise be free flowing. The project currently operates in a peaking mode, with allowable impoundment fluctuations of up to 8 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1250 cfs), but can increase rapidly during times of power generation.

Operations at the three projects have the potential to cause direct adverse effects to odonate habitat within the project area, and effect survival of during emergence. The Agency requests a study assess whether project operations are having any adverse effects to these populations.

Proposed Methodology

Study methods similar to those from Morrison, F., McLain, D., and Sanders, L. 2006. *A Survey of Dragonfly Emergence Patterns Based on Exuvia Counts and the Results of River Bottom Transects at Selected Sites in the Turners Falls Pool of the Connecticut River, 2006 Field Season* This would provide valley wide consistency in methodology.

Level of Effort and Cost

The estimated level of effort and costs for this recommended study is expected to be moderate. The applicant did not propose any alternative studies in its PAD to address this specific issue.

Literature Cited

[1]Dragonfly Studies
http://www.restoreconnriver.org/dragonfly_studies.php
© 2007 Franklin Regional Council of Governments, 425 Main Street, Suite 20, Greenfield, MA 01301-3313 Ph: 413-774-3167 | Email: info@frcog.org

[2]Vermont's Wildlife Action Plan. 2005. Vermont Fish & Wildlife Department. Waterbury, Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm.

Wilder Hydroelectric Project – FERC No. 1892-026
Bellows Falls Hydroelectric Project – FERC No. 1855-045
Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 30: Survey for new and existing populations of adult Cobblestone and Puritan tiger beetle populations within the project areas

Goals and Objectives

The goal of this study is to conduct a survey to detect and gather information on known and new Cobblestone and Puritan tiger beetle populations along the Connecticut River throughout the project area (including the impoundments and downstream in the free flowing reaches), and to determine the potential impact from project operations on tiger beetles.

The objectives of this study are:

- Obtain baseline distributional and abundance data and map occurrences of Cobblestone and Puritan tiger beetle populations along the Connecticut River throughout the three project areas.
- Define the particular habitat requirements of each species.
- Assess the vulnerability of each species to disturbances such as siltation, flow fluctuations, and changes in shoreline composition and vegetation.
- Identify areas within the project areas where suitable habitat may exist for tiger beetles and the portion affected by project operations.
- Determine if project operations are adversely affecting the survival success of tiger beetle and beetle larva.
- If it is determined that the project operations are adversely affecting survival, identify operational regimes that will reduce and minimize impacts to tiger beetle and tiger beetle habitat within the project area.

Resource Management Goals

Vermont threatened and endangered species are protected by Vermont's Endangered Species Law (10 V.S.A. section 5401 et. seq.). The Agency of Natural Resources conservation goals for endangered species are:

1. Maintain or increase populations of rare, threatened, and endangered species in the town or area of interest.
2. Maintain, restore, provide stewardship for, and conserve habitats and natural communities that support rare, threatened, and endangered species.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Two tiger beetle species within the Connecticut River drainage are listed as Vermont's Species of Greatest Conservation Need (SGCN), the Cobblestone tiger beetle (state-threatened species) and the Puritan tiger beetle (federally-threatened species). [1]

Conversion of habitat, habitat alteration, habitat succession, inadequate disturbance regime and sedimentation are all identified in the Vermont Wildlife Action Plan (VWAP) as current problems facing tiger beetles. [1]

A high priority strategy in the VWAP for tiger beetle management is easement acquisition of high priority SGCN tiger beetle riverine sites. [1]

Protecting and restoring aquatic and riparian habitats through improved water quality; flow, water level and temperature regimes; sediment reduction; establishment of streamside buffers; and suitable aquatic habitat structure, diversity and complexity is a conservation strategy identified in the VWAP for aquatic species. [1]

Results of the survey will be used to develop flow-related license requirements and/or other mitigation measures that will optimize habitat for these Vermont SGCN.

Public Interest Consideration

The requestor is a state resource agency.

Existing Information

The Puritan tiger beetle (*Cicindela puritana*) is a federally threatened species only known historically from a single Vermont site, although other historic sites were known along the New Hampshire side of the river. [1]

Impoundments along the Connecticut River likely caused the extirpation of this species. Other habitat losses may have also been a factor. Reintroduction could be considered if sufficient habitat improvements are made. Riverside recreational use has had a significant impact on populations at other New England sites. Historically found along lower portion of Connecticut River in Hartland, VT and nearby NH sites, this species prefers wide sand deposits along big rivers or narrow beaches along rivers with clay banks.[1]

The Cobblestone tiger beetle (*Cicindela marginipennis*) is a state-threatened species and has been studied in Vermont to a greater degree than other *Cicindela* species. Habitat losses along the Connecticut River and possibly other rivers have been significant due to impoundments. *C.*

marginipennis is found in the lower Connecticut River, White River, West River, and single Winooski River, Southern Vermont Piedmont and Northern Green Mountains. [1]

The Cobblestone tiger beetle is in extremely restricted habitat, being found on cobble beaches of shores and islands of large rivers. Adults inhabit areas of cobble and sand where vegetation is very sparse. Larvae occupy burrows in the sand along the edges of cobblestones. [1]

Project Nexus

The project impounds several miles of river that otherwise would be free flowing. Currently the projects operate in a peaking (daily run-of-river) mode resulting in large and rapid changes in flow below the dams. Rapid changes in flow and water level have the potential to cause direct adverse effects to tiger beetle habitat within the three project areas. If tiger beetles inhabit the project areas, it is important to assess whether project operations are having any adverse effects to these populations. The Agency request a study to determine the effects of project operations on cobblestone and puritan tiger beetles.

Proposed Methodology

The methodology should be similar to that used by Brust, M. L., Hoback , W. W. and Johnson, J. J., *Fishing for Tigers: A Method for Collecting Tiger Beetle Larvae Holds Useful Applications for Biology and Conservation*, 2010, The Coleopterists Bulletin 64(4):313-318.

Results should include presence, relative abundance, evidence of reproduction, and available habitat. Additionally, the methodology should collect information on habitat used by each species of tiger beetles and identify potential habitat. The portion of habitat that is affected by project operations should also be determined, and the frequency of inundation of each site.

Level of Effort and Cost

The estimated level of effort and costs for this recommended study is expected to be moderate. The applicant did not propose any alternative studies in its PAD to address this specific issue.

Literature Cited

[1]Vermont's Wildlife Action Plan. 2005. Vermont Fish & Wildlife Department. Waterbury, Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm.

Wilder Hydroelectric Project – FERC No. 1892-026
Bellows Falls Hydroelectric Project – FERC No. 1855-045
Vernon Hydroelectric Project – FERC No. 1904-073

*Study Request 31: Survey the distribution, population size and habitat conditions of Fowler's Toad (*Bufo fowleri*) within the project areas*

Goals and Objectives

The goal of this study is to conduct a survey to obtain baseline distributional and abundance data on Fowler's Toads along the Connecticut River throughout the project areas to determine the potential impacts of project operations.

The objectives of the study are:
Survey for and map occurrences of Fowler's Toads and suspected hybrids with American Toads.

Define the preferred habitat requirements of the species.

Document and map current and suitable habitat, including connectivity of patches.[1]

Assess the vulnerability of Fowler's Toads to project operations such as flow fluctuations, siltation, and changes in shoreline composition and vegetation.

Determine if Project operations are adversely affecting the survival success of Fowler's Toads (i.e. if flow alterations are impacting breeding habitat).

If it is determined that the Project operations are adversely affecting survival, identify operational regimes that will reduce and minimize impacts on Fowler's Toads and Fowler's Toad habitat within the project area.

Resource Management Goals

The Agency's goals related to aquatic natural resources are to:

1. Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
2. Provide an instream flow regime that meets the life history requirements of resident fish and wildlife (including invertebrates such as freshwater mussels) throughout the area impacted by project operations.
3. Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat. Furthermore, the VTFWD's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont" (Kart et al. 2005).

Two of the Department's planning goals are:

1. Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
2. Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Fowler's Toad populations have been documented within the Connecticut River drainage in the Project area.[1]

The Fowler's Toad is a Vermont's Species of Greatest Conservation Need (SGCN). It is currently being considered for recommendation as an endangered species by the Vermont Endangered Species Committee (See Appendix B). It is ranked as an S1, Very Rare species.[1]

Fowler's Toads breed in Vermont in shallow pools along the disturbed shoreline of the Connecticut River and perhaps its larger tributaries. It forages and overwinters primarily in well-drained sites, particularly floodplain forests and sandy deciduous woodlands along shorelines and river valleys, but may also occupy gardens, lawns, and fields.[1].

Fowler's Toads have specialized breeding habitat requirements that benefit from shoreline disturbance as a result of flooding and wave action. They also undergo regular short-term population fluctuations. Any habitat conversion, alteration, or fragmentation that disrupts the species' ability to move between breeding and terrestrial sites as well as recolonize appropriate habitat may have negative effects.[1]

Conversion of habitat, habitat alteration, and habitat fragmentation are all identified in the Vermont Wildlife Action Plan (VWAP) as current problems facing Fowler's Toads.[1] In addition, a lack of flood events that would deposit sand and gravel along the shoreline of the Connecticut River and clean away vegetation, will limit appropriate breeding habitat.

A strategy in the VWAP for Fowler's Toad management is to protect currently known breeding sites and adjacent terrestrial habitat through easement or purchase.[1]

Protecting and restoring aquatic and riparian habitats through improved water quality; flow, water level and temperature regimes; sediment reduction; establishment of streamside buffers; and suitable aquatic habitat structure, diversity and complexity is a conservation strategy identified in the VWAP for aquatic species.[1]

Results of the survey will be used to develop flow-related license requirements and/or other mitigation measures that will optimize habitat for this Vermont SGCN.

Public Interest Consideration
The requestor is a state resource agency.

Existing Information

To date no studies have been conducted to identify Fowler's Toad populations within the three project areas and whether Project operations are affecting these populations.

Project Nexus

The Wilder Project impounds 45 miles of river that would otherwise be free flowing. The project currently operates in a peaking mode, with allowable impoundment fluctuations of up to 5 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (675 cfs), but can increase rapidly during times of power generation.

The Bellows Falls Project impounds 26 miles of river that would otherwise be free flowing. The project currently operates in a peaking mode, with allowable impoundment fluctuations of up to 3 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1080 cfs), but can increase rapidly during times of power generation.

The Vernon Project impounds 26 miles of river that would otherwise be free flowing. The project currently operates in a peaking mode, with allowable impoundment fluctuations of up to 8 feet, with proposals to continue as such. The below-project flow requirement is equal to 0.20 csm (1250 cfs), but can increase rapidly during times of power generation.

Project operations have the potential to cause direct adverse effects to Fowler's Toad habitat within the three Project areas. Releases that mimic natural flood events would probably benefit this species by creating and maintaining breeding habitat. Since Fowler's Toads are known to inhabit the project areas, it is important to assess whether Project operations are having any adverse effects to their populations.

Proposed Methodology

Adapt methods below to river shores:
Amphibian Calling Surveys, Author: Sam Droege, USGS Patuxent Wildlife Research Center, 12100 Beech Forest Rd., Laurel, MD 20708, frog@usgs.gov, 301-497-5840.
http://www.pwrc.usgs.gov/monmanual/techniques/amphibcallingsurveys.htm

Improving calling surveys for detecting Fowler's toad, Bufo fowleri*, in southern New England, USA*, Todd A. Tupper, Robert P. Cook, Brad C. Timm, and Amy Goodstine
http://www.nps.gov/caco/naturescience/upload/Bufo_fowleri_Poster_Tupper.pdf

May also include nighttime wet road surveys, near-shore boat surveys, the use of FrogLoggers and environmental DNA sampling.

Level of Effort and Cost

The estimated level of effort and costs for this recommended study is expected to be moderate. The applicant did not propose any alternative studies in its PAD to address this specific issue.

Literature Cited

[1]Vermont's Wildlife Action Plan. 2005. Vermont Fish & Wildlife Department. Waterbury, Vermont. http://www.vtfishandwildlife.com/swg_cwcs_report.cfm.

Wilder Hydroelectric Project – FERC No. 1892-026
Bellows Falls Hydroelectric Project – FERC No. 1855-045
Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 32: Recreational survey and enhancement study

Goals and Objectives
The goal of this study is to identify opportunities for improving recreational opportunities at project facilities and on project lands, including new or improved recreational facilities and changes in project operations.

The objectives are to:
- Survey recreational users and potential users to identify to what extent existing recreational opportunities are being utilized by the public within the project boundaries and why potential recreational users are not using the resource.
- Identify any safety issues to recreational users from project operations, how project operations impacting recreational users and how operations could be modified to improve recreational opportunities.
- Identify how recreational opportunities in the vicinity of the project could be developed to enhance future recreational opportunities, including, but not limited to, river access points, primitive camping sites, improvement in portage trails, etc.

Resource Management Goals
The 1993 Vermont Recreation Plan (Vermont Department of Forests, Parks and Recreation), through extensive public involvement, identified water resources and access as top priority issues. The planning process disclosed that recreational use of surface waters is increasing, resulting in greater concern about water quality, public access to Vermont's waters, and shoreland development. The plan's Water Resources and Access Policy states:

> It is the policy of the State of Vermont to protect the quality of the rivers, streams, lakes, and ponds with scenic, recreational, cultural and natural values and to increase efforts and programs that strive to balance competing uses. It is also the policy of the State of Vermont to provide improved public access through the acquisition and development of sites that meet the needs for a variety of water-based recreational opportunities.

Another priority issue identified in the Recreation Plan is the loss or mismanagement of scenic resources. The plan notes "[t]he protection of the scenic and visual resources in Vermont is paramount if Vermont is to maintain its renowned charm and character."

The Connecticut River is considered Class B waters. Vermont Water Quality Standards require that Class B waters be managed to provide full support for all recreational uses, including swimming and other primary contact forms of recreation and boating, fishing and other recreational uses.

Public Interest Consideration
The requestor is a state natural resource agency.

Existing Information
The PAD provides information on the existing recreational resources, but does not provide information on how project operations adversely affect recreational opportunities or perceptions of recreational users utilizing opportunities in the project areas.

Project Nexus
These projects affect the Connecticut River from the vicinity of Wells River, Vermont to the Massachusetts boundary. Recreational opportunities on these public waters are affected by the presence of the projects and their operation. The Agency requests a recreational assessment that can be used to inform the development of recreational plans for the projects.

Proposed Methodology
The proposed study methodology should include an inventory of all the recreational facilities and opportunities within the project boundary, and a determination of the number of recreational users utilizing the resources. The study should include a component to survey an equal proportion of recreational users utilizing different activities to determine how project operations affect their recreational use and experience, and identify any safety issues associated with project operations or current recreational facilities. Potential recreational users in the area should be identified to determine why potential recreational users do not use the resource. An analysis of the recreational facilities should be conducted to identify future projects that could improve the recreational resources and/or the need to improve existing recreational facilities or access to the resource.

The approach used during the relicensing of TransCanada’s Fifteen Mile Falls Project can serve as a model.

Level of Cost and Effort
The cost and effort of this study will be moderate, but it will provide essential information for certification and licensing of the projects.

Wilder Hydroelectric Project – FERC No. 1892-026
Bellows Falls Hydroelectric Project – FERC No. 1855-045
Vernon Hydroelectric Project – FERC No. 1904-073

Study Request 33: Assess the amount of development within the floodplain of the lower Connecticut River

Goals and Objectives
The goal of this study is to determine the number of developments within the 100 year floodplain to determine if river profile operations during high flow events, aimed to reduce overland flow and contain flows to the channel, are necessary to protect public or community economic investments.

The objectives of this study are:
- Determine the number of public and community development within the 100 year floodplain in New Hampshire and Vermont.
- Determine if river profile operations could be modified in locations to allow over land flow in the floodplains where waters would not cause damage or endanger public safety and community investments.

Resource Management Goals
The Connecticut River is classified by the state of Vermont as Class B cold water fish habitat. Vermont Water Quality Standards state that Class B waters should be managed to achieve and maintain a level of quality that fully supports aquatic biota, wildlife or habitat.

Under Act 138 (Sec. 9. 10 V.S.A. § 1427) – River Corridor and Floodplain Management, the Agency is responsible for identifying where the sensitivity of a river poses a probable risk of harm to life, property, or infrastructure, and to develop recommended best management practices for the management of river corridors, floodplains, and buffers.

Public Interest Consideration
The requestor is a state natural resource agency.

Existing Information
The PAD does not provide any information on this topic.

Project Nexus
The PAD indicates that at all three projects have river profile operations during high flow events. The PAD states that during high flows the dams operate with the goal to reduce overland flow and contain flow to the channel. During river profile operations the impoundments are drawn down prior to high flow events to allow inflows to stay within the channel and reduce the flow entering the river floodplain communities. The Agency requests a study to determine if river profile operations are necessary to protect public safety, community or public economic investment.

Proposed Methodology

The Agency recommends that the Licensee use the latest Flood Insurance Studies to determine the number of residents, commercial buildings or other infrastructure within the 100 year floodplain. If a recent Flood Insurance Study has not been completed, aerial photos could be used with the 100 year floodplain for the Lower Connecticut River overlaid to complete the study.

Level of Effort and Cost

The effort and cost of this study is expected to be relatively low, but is important to document the potential impact operations have on floodplain communities and whether river profile operations are necessary to protect public safety and investments.

Bellows Falls Hydroelectric Project – FERC No. 1855-045

Study Request 34: Bellows Falls aesthetic flow study

Goal and Objective
The goal of this study is to determine the flow required at Bellows Falls dam and bypass reach to support aesthetics under the Vermont Water Quality Standards.

Resource Management Goals
The Connecticut River is considered a Class B waters. Good aesthetic values are a management objective for Class B waters in Vermont. Vermont's Water Quality Standards provide that waters shall be of a quality that consistently exhibits good aesthetic values, including water character, flows, water level, bed and channel characteristics.

Public Interest Consideration
The requestor is a state resource agency.

Existing Information
The PAD provides limited information on this issue, only briefly indicating that during flows that exceed project capacity that the excess is spilled over the dam into the bypass reach. During other times of year no minimum flow is required in the bypass reach, and the amount of flow present is determined by the amount of spillage.

Project Nexus
Flow over the dam and in the bypass reach directly impacts aesthetics, which must be supported to conform to Vermont Water Quality Standards. The Agency requests a study of alternate spillage flows at the facility. This information will be needed before the Agency can certify that the project meets Vermont Water Quality Standards.

Proposed Methodology
A range of alternate spillages can be videotaped and qualitatively analyzed, or a demonstration study can be arranged for direct observation of flows by a team for subjective grading. If the latter approach is used, the flows should be documented using both still photographs and videotaping. Typically, a range of flows are observed from several vantage points. If direct observation is used, a rating form is employed to provide a structure for the individual observations.

Level of Effort and Cost
The effort and cost would be determined by the approach used. Under appropriate conditions, one day of field work should be required.

Vermont Agency of Natural Resources

Study Requests for Wilder, Bellows Falls and Vernon Projects

Appendix A

Natural Community Survey Form

NATURAL COMMUNITY SURVEY FORM

Natural Heritage Inventory (NHI)

Vermont Fish and Wildlife Department

Revised: October 16, 2012

Contact Eric Sorenson with questions about natural communities or this form: 802-476-0126; eric.sorenson@state.vt.us

Natural Community Type: Click here to enter text.

Natural Community Variant Name (if applicable): Click here to enter text.

Association Name (NHI office only): Click here to enter text.

Is this an update of an existing NHI record? (NHI office only) Yes ☐ No ☐

Site Name: Click here to enter text.

Site Location Road Address: Click here to enter text.

Town: Click here to enter text.

Surveyor(s): Click here to enter text.

Mailing Address: Click here to enter text.

Phone: Click here to enter text.

E-mail: Click here to enter text.

Survey Date(s): Click here to enter text.

Owner(s) of Natural Community: Name(s): Click here to enter text.

Address: Click here to enter text.

Phone: Click here to enter text.

E-mail: Click here to enter text.

GENERAL DESCRIPTION OF THE SITE

Briefly describe the natural and man-made features of the site and setting in which the natural community occurs, including topography, size of the contiguous forested area, other natural community types present, surface waters and drainage patterns, and land use history and land management.

Click here to enter text.

NATURAL COMMUNITY INFORMATION

Concisely describe the natural community, including canopy cover, dominant species, the physical setting, evidence of human and natural disturbance, forest community age, woody debris abundance, and presence of invasive species.

Click here to enter text.

Elevation (feet): minimum: Click here to enter text. **maximum**: Click here to enter text.

Slope (degrees): Click here to enter text.

Aspect (degrees or cardinal direction): Click here to enter text.

Bedrock geologic type (2012 VT bedrock geology map): Click here to enter text.

Soil type (Natural Resources Conservation Service) or description: Click here to enter text.

Vegetation Description: To be applied to a representative area of the community large enough to capture most species.

Total Canopy Cover: Click here to enter text.% Total Shrub Cover: Click here to enter text.%

	Trees			Shrubs				
	T1Emergent	T2 Canopy	T3 Subcanopy	S1 Tall (> 4 ft.)	S2 Short (<4 ft.)	H Herbaceous	N Nonvascular	V Vine
Height (ft.)								
% Cover								

Dominant Species and their cover for each stratum (T1- emergent, T2-main canopy, T3-subcanopy, S1-tall shrub, S2-short shrub, H-herb, N-nonvascular, V-vine). Give average DBH (inches) for trees. For each species estimate actual percent cover or use one of the cover class categories below. Use the species list table below or attach a separate sheet.

Stratum	**Species**	**DBH**	**Cover**	**Stratum**	**Species**	**Cover**

Cover Classes	
r	**< 1% rare**
+	**< 1% occs**
1	**1-5 %**
2	**6-25 %**
3	**26-50 %**
4	**51-75 %**
5	**76-100 %**

OR

Cover Classes	
D	**Dominant; cover > 50%**
C	**Common; 6 to 50 % or numerous individuals**
O	**Occasional; 1 to 5% or scattered individuals**
R	**Rare; < 1% or one to a few individuals**

Provide ages for representative trees in the community (optional).

Tree Species	DBH	Age

Comments about the natural community that do not fit in another field:

Click here to enter text.

NATURAL COMMUNITY MAPPING

Attach GIS shapefiles (preferred) or digital or paper map of the natural community boundaries with labeled polygons.

Estimate percent of mapped polygon occupied by the natural community: >95%☐; 80-95%☐; 20-80%☐; 0-20%☐
Explain if <95%, explain what other communities are present: Click here to enter text.

Indicate type and scale of Base Map used to map the natural community: Click here to enter text.

Confidence in the Extent of the Natural Community as Mapped (check one)

☐ Confident that the full extent is known and mapped:

☐ Full extent is not known:

☐ Uncertain if full extent is known:

Comments: (If the natural community extends off the subject property, explain, and estimate total area of community.)

Click here to enter text.

COMMUNITY OCCURRENCE RANKING: a range of ranks may be used (such as AB)

Using **VT NHI ranking specifications** (if available)*: OR Using **Generic ranking specifications** (provided below):

	Rank (A-D)	**Comments**
Current Condition		Click here to enter text.
Landscape Context		Click here to enter text.
Size (acres)		Community size and how determined: Click here to enter text.
Overall Rank		Click here to enter text.

* Available for some natural communities from Eric Sorenson (eric.sorenson@state.vt.us) or 802-476-0126.

Generic ranking specifications

Use the following guidelines to fill in the grid above if VT NHI ranking specifications are not yet available for the community type.

Current Condition

A: mature example of the community type (forests with trees generally >150 years old); natural processes intact; no exotics
B: some minor alteration of vegetation structure and composition, such as by selective logging; minor alterations in ecological processes; exotics species present in low abundance
C: significant alteration of vegetation structure and composition, such as by heavy logging; alteration of ecological processes are significant, but community recovery/restoration is likely; exotic species are abundant and control will take significant effort

D: ecological processes significantly altered to the point where vegetation composition and structure are very different from A-ranked condition and restoration/recovery is unlikely; exotic species are abundant or control will be difficult

Landscape Context

A: highly connected; area around EO (>1,000acres) is largely intact natural vegetation, with species interactions and natural processes occurring across communities; surrounding matrix forest meets at least B specifications for Condition.
B: moderately connected; area around EO (>1,000acres) is moderately intact natural vegetation, with species interactions and some natural processes occurring across many communities, although temporary disturbances such as logging have reduced condition of the landscape; surrounding matrix forest meets at least C specifications for Condition

C: moderately fragmented; area around EO is largely a combination of cultural and natural vegetation with barriers to species interactions and natural processes across communities; surrounding land is a mix of fragmented forest, agriculture, and rural development

D: highly fragmented; area around EO is entirely, or almost entirely, surrounded by agriculture or urban development

Size

No Generic ranking applicable. Please provide size of community in grid above.

Overall Rank (based on best judgment)

A: excellent estimated viability

B: good estimated viability

C: fair estimated viability

D: poor estimated viability

NATURAL COMMUNITY MANAGEMENT

Discuss management needs and plans for this natural community, including need for invasive species monitoring and control. If the natural community requires a buffer with specific management, describe and map the buffer width and specifically explain the ecological need for the buffer:

Click here to enter text.

ADDITIONAL INFORMATION; (none required) (check those that are attached):

☐ Additional plant species list attached

☐ Plot form(s) attached

☐ Animal list attached

Please send completed form and GIS shapefiles to Eric Sorenson:

eric.sorenson@state.vt.us

or

Eric Sorenson

Natural Heritage Inventory

Vermont Fish and Wildlife Department

5 Perry Street, Suite 40

Barre, Vermont 05641

Vermont Agency of Natural Resources

Study Requests for Wilder, Bellows Falls and Vernon Projects

Appendix B

Documentation for the listing of the Fowler's Toad as an endangered species in Vermont

SPECIES STATUS REVIEW

STATE OF VERMONT
ENDANGERED SPECIES COMMITTEE

Common Name: **Fowler's Toad**	Current Status: **None** (Special Concern by SAG - Reptiles & Amphibians, S1 Vermont Heritage Rank, and high priority SGCN)
Scientific Name: ***Anaxyrus fowleri*** **(Previously** ***Bufo fowleri*****)**	Recommended Status: **Endangered**
Scientific Advisory Group Chair: James S. Andrews	Endangered Species Committee Chair: Sally Laughlin
Date:	Date:

Wildlife and plant species are added to or removed from the list of endangered and threatened species by action of the Secretary of the Agency of Natural Resources, upon recommendation of the Vermont Endangered Species Committee, according to 10 V.S.A., Chapter 123. The Vermont Endangered Species Committee is advised by scientific advisory groups on vascular plants, non-vascular plants, invertebrates, fish, reptiles and amphibians, birds, and mammals.

DEFINITIONS

ENDANGERED: A species that normally occurs in the State and whose continued existence as a viable component of the State's wild fauna or flora is in jeopardy, or a species determined to be an endangered species under the Federal Endangered Species Act. [V.S.A. Title 10, Chapter 123, Sections 5401(6) & 5402(b).]
THREATENED: A species whose numbers are significantly declining because of loss of habitat or human disturbance and unless protected will become an endangered species, or a species determined to be a threatened species under the Federal Endangered Species Act. [V.S.A. Title 10, Chapter 123, Section 5401(7) & 5402(c).]

GUIDELINES FOR LISTING AS ENDANGERED OR THREATENED

1. Species (including subspecies and varieties) which may be listed include all wild and free-ranging or naturally-occurring mammals, birds, amphibians, reptiles, fish, invertebrates, vascular and non-vascular plants.
2. Species which may be listed include those native to the State or known to exist as viable, naturalized populations in Vermont.
3. Species which may be listed must have spent at least some portion of their life cycle in Vermont on a sustained basis, breeding or otherwise.
4. Species listed by the Secretary of the Interior as endangered or threatened in the U.S., if occurring as historical or current residents or transients in Vermont, shall be listed in their respective categories.
5. Attached to this review shall be a SPECIES DOCUMENTATION including the best scientific information available with sources cited.
6. The Endangered Species Committee and its scientific advisory groups shall consider the CATEGORIES and CRITERIA FOR LISTING when recommending species for listing or delisting, using the best scientific information available and their best expert judgments.
7. Specific numbers cited in the Primary Criteria of the CRITERIA FOR LISTING are guidelines only, and are to be interpreted with respect to the biology of the species. Definitions of terms such as *population* and *reproductive potential* for each species shall be provided by the appropriate scientific advisory groups according to accepted practices in their field of biology.

(Guidelines continued on page 2)

CRITERIA FOR LISTING AS ENDANGERED OR THREATENED

1.0 **ENDANGERED**

____ 1.1 The species is known to have occurred historically in Vermont but has not been documented in the last 25 years; OR

__X__ 1.2 The species meets at least one of the following primary criteria of rarity:

- __X__ 1.2.1 There are estimated to be three or fewer viable, reproducing populations separated by unfavorable habitat in Vermont; OR
- __X__ 1.2.2 There are estimated to be fewer than 100 reproducing individuals in Vermont; OR
- ____ 1.2.3 The species is known in the last 25 years from 20 or fewer sites throughout its global range;

AND one of the following secondary criteria:

- ____ 1.2.4 The species has declined overall or noncyclically throughout a significant portion of its global range; OR
- ____ 1.2.5 The species is restricted to localities within or immediately adjacent to Vermont; OR
- __X__ 1.2.6 One or more special factors cause the species to be vulnerable to extirpation:
  - ____ 1.2.6.1 The species is in danger of exploitation or is threatened with disturbance; OR
  - __X__ 1.2.6.2 The species occurs in rare or specialized habitat that is vulnerable to loss, modification, or variations in quality; OR
  - ____ 1.2.6.3 The species has low reproductive potential or is experiencing reduced reproductive success; OR
  - __X__ 1.2.6.4 The species has other factors that render it vulnerable to extirpation (*list*).
    This species was last documented from Vermont in 2007. Since known populations have declined precipitously, there are clearly factors or combinations of factors that occur (or did occur) that render it vulnerable to extirpation. However, it is unclear exactly what factors or combination of factors brought about the current decline. In addition to habitat loss, habitat modification, and habitat fragmentation as listed above, this species has also shown sensitivity to lowered pH, herbicides, pesticides, some metals, road mortality, disease, parasites, and weather extremes such as those that could bring about mortality as a result of freezing (cold weather and lack of snow) or dehydration (drought). In addition, the cyclical nature of these populations in itself renders this species more vulnerable as it requires repopulation across an increasingly fragmented landscape. These threats are all discussed in greater detail in the species documentation.

Fowler's Toad (*Anaxyrus fowleri*)
Narrative Summary
December 18, 2012

The Endangered Species Committee recommends to the Secretary of Natural Resources that the Fowler's Toad (*Anaxyrus fowleri*) be listed as Endangered.

Fowler's Toad (*Anaxyrus fowleri*, previously *Bufo fowleri*) is a close relative of the more common American Toad (*Anaxyrus americanus*). The Fowler's Toad is an edge of range species that seems to have always been limited in distribution in Vermont. The Fowler's Toad was last documented in Vermont in 2007. We do not know what has caused this recent decline.

We have very little historical data on some of our rare reptiles and amphibians in Vermont. For example the Four-toed Salamander (*Hemidactylium scutatum*) was first documented in Vermont in 1960 and our only known large population of Spotted Turtles (*Clemmys guttata*) was not discovered until 2010. Both of these species are presumed to have existed in Vermont for hundreds if not thousands of years prior to our discovery of their presence.

Fowler's Toad was first reported and photographed in Vermont in 1983 in White River Junction (town of Hartford; Andrews, 2011) where it was reported as numerous. They have been reported from three other sites in the Connecticut River Valley of Vermont. A population in Vernon was well documented from 1994 through 2007.

Breeding choruses took place along the shores of the Connecticut River in Vernon and its islands (NH). Despite general herpetological survey efforts and multiple targeted surveys covering Windham County, no additional Fowler's Toads have been seen. Repeated (26 visits) and targeted surveys in 2008 by a graduate student from Antioch New England, did not locate any Fowler's Toads in the Vernon area or any surrounding areas including south of the Massachusetts border. Disturbed river-shore seems to be the primary breeding habitat used by this species in Vermont.

Species whose habitat needs are more restrictive and whose numbers are limited are at a heightened risk from anthropogenic and natural events. Since we have been unable to locate this species in Vermont since 2007, there are clearly factors or combinations of factors that occur (or did occur) that render it vulnerable to extirpation. However, it is unclear exactly what factors or combination of factors brought about the current low population levels. Controlling flooding along the lower Connecticut River may be limiting the creation of appropriate breeding habitat for this species. Gravel and sand deposits in the lowlands are prime development areas. Increased road building and road traffic in the river valleys are direct threats to individuals and general threats to breeding and foraging habitats and safe movement between them. In addition, this species has shown sensitivity to lowered pH, herbicides, pesticides, some metals, disease, parasites, and weather extremes such as those that could bring about mortality as a result of freezing (cold weather and lack of snow) or dehydration (drought). This species has undergone short-term population swings in Ontario but the duration of the swings is much shorter than the period of time since we last observed this species in Vermont. The short-term cyclical nature of these populations in itself renders this species more vulnerable particularly if it requires repopulation across an increasingly fragmented landscape.

Populations of species at the edge of their ranges often carry unique gene combinations selected for by the specific environmental conditions at their edge locations. These genetic differences often allow them to survive weather extremes, disease, or other stressors that other populations of the same species would not be able to survive. Some studies of vertebrates have shown declines in populations taking place from the center of a species range to the edges, with the marginal populations surviving after more central populations have disappeared. Hence conserving edge-of-range populations is an important step toward conserving populations as a whole and the genetic diversity within species.

We are concerned that this species does not have the appropriate conservation status in Vermont and hence that it does not get the conservation attention it deserves from state, regional, and local planners and managers; as well as local conservation commissions and land owners.

Benefits of listing this species:

- Increased awareness of natural resource planners and land managers (e.g., Regional Planning in Windham County did not have this species on its radar screen as a result of its not being listed. Local entities and landowners are not aware of the relative significance of this species and its habitat).

- Make it easier for land conservation organizations, conservation commissions, planning commissions, land owners, the Vermont Fish and Wildlife Department, and other land managers to justify allocating time and money for the monitoring and conservation of this species.

- Increase the availability of federal and private funding to governmental and non-governmental organizations, and individuals for conservation of this species.

- Provide accurate and current information on the status of Vermont's wildlife species to the citizens of Vermont by assigning this species its appropriate status under Vermont law.

I. Species Documentation

A. STATE OF VERMONT

1. ENDANGERED SPECIES COMMITTEE

1.	Scientific Name:	*Anaxyrus fowleri* (Previously *Bufo fowleri*)
2.	Common Name:	Fowler's Toad
3.	Species Code (*Department use only*):	
4.	Current Vermont Status:	S1, SC, High Priority SGCN
5.	Recommended Vermont Status:	Endangered
6.	Federal Status:	US: None, Global status S5
7.	Surrounding State & Provincial Status:	Canada: Endangered (COSEWIC, April 2010) NH S3, NY & CN S4 MA S4 (but extirpated from Nantucket, Muskeget, & Cuttyhunk) Ontario: Endangered (SARO)

POPULATION STATUS

8. Global, North American, and Vermont Ranges:

This species distribution is centered in the eastern US from the Mississippi drainage to the Atlantic coast but not including the Florida peninsula, coastal North or South Carolina, or northern Michigan, northern New York, northern New Hampshire, or any of Maine. However, in the Midwest this species has recently disappeared from portions of its former range in Ohio and other states where it was once common (Quinn and Scott, 2005). It is not native anywhere else in the world (see map below).

In New Hampshire this species has not been monitored (Mike Marchand pers. comm., 2011). However, reports exist from Hinsdale (2002) and Westmoreland (2001) along the Connecticut River in Cheshire County, from Boscawen (1938 & 2011) and Concord (1997 & 2002) along the Merrimack River in Merrimack County, and from Enfield (2004) and Grafton (2004) in the Mascoma Valley of Grafton County (2004). The Enfield site is approximately 10 miles east of our Hartford records.

The stronghold for this species in New York State is Long Island. However, populations reach north along the Hudson River drainage to the Albany Pine Bush (where they have been difficult to locate in the last 10 years). They were rarely reported anywhere east of the Hudson River in upstate New York (Al Breisch pers. comm., 2011).

In Canada this species "only occurs on sandy beaches in three disjunct areas along the north shore of Lake Erie (Ontario). It has disappeared from numerous historic sites on the Lake Erie shore and continues to decline in abundance and number" (COSEWIC, 2010).

In Massachusetts, Fowler's Toads are primarily located on or near Cape Cod but they were also found along the Connecticut River as far north as Amherst during the 1992-1998-atlas effort (Jackson et al., 2010).

In Vermont, Fowler's Toad was found along the southern Connecticut River Valley reaching as far north as White River Junction (Hartford) in the early- to mid-1980s but it has been found only in Vernon during the last two decades with the exception of one 2002 report from along the Saxton's River in Rockingham. It was last reported from Vernon in 2007.

9. Vermont's Position within Global Ranges: ____ Central __X__ Peripheral _____ Disjunct

10. Historic Occurrences in Vermont More Than 25 Years Ago (*Type, Number, General Location, Regularity of Use, Confidence in Records, etc.*):

This species had been confused with others from the same genus (American toad, *Anaxyrus americanus* in this area) in the past. It was first reported in Vermont in 1983 by Michael Caduto and Margaret Barker in White River Junction (town of Hartford). They reported numerous sightings in the vicinity of Hillcrest Terrace in that year and documented one sighting with a photograph. Doug Kibbe remembers hearing what he was convinced were Fowler's Toads from Allen Brother's Marsh in Westminster in late May 1985 but this report was not accompanied by photographs. Additional visits to these sites have not turned up any more recent reports. These locations made sense as an extension of the Connecticut River lowlands populations of Massachusetts. However, they were quite distant from the nearest populations in Massachusetts and no other populations were known in Vermont at that time.

The 1983 report served as a wake-up call for those collecting data on Vermont's amphibians. From then on, toads were checked carefully to rule out the possibility of Fowler's Toads. However, no other toads of this species were located at any site until they were located in Vernon in 1994. This species has a very distinctive call, quite unlike that of American Toads. Consequently it is fairly easy to locate during its calling season if it is present.

11. Historic Abundance More Than 25 Years Ago (*number of Breeding Individuals or Size of Area Occupied, Confidence in Records, etc.*):

The Hartford records were documented, photographed, and published. Mark DesMeules (Vermont Nongame and Natural Heritage Program at that time), Jim Andrews (Vermont Reptile and Amphibian Atlas 2011), and others confirmed the identification from the photo. Caduto and Barker reported numerous sightings in the vicinity of Hillcrest Terrace in 1983. We have no other data on the historic abundance of this species in Vermont. Historical abundances throughout the range of this species are unknown but populations have been known to vary widely over time and space (Breden, 1988; Green 1992, 1997; Hranitz et al., 1993).

12. Current Occurrences in Vermont (*Type, Number, General Location, Regularity of Use, Confidences in Records, Extent to which the Species has been Inventoried, etc.*):

This species was last documented in Vermont in 2007. Since the initial discovery of this species in Vermont in Hartford in 1983, we have gathered 19 reliable reports of this species from the southern Connecticut River Valley. The next report came in 1985 from Allen Brother's Marsh in Westminster. This marsh is in the immediate flood plain of the Connecticut River and the report of calls heard comes from experienced naturalist Doug Kibbe. After that report, there are no new reports until Jim Andrews traveled to the region in 1994 along with some students with the specific goal of finding Fowler's Toads. During that brief but focused survey, Fowler's Toads were found only along Stebbins Road in Vernon. Stebbins Road is a sparsely developed rural road on a plateau above the current floodplain of the Connecticut River. On that trip a minimum of four Fowler's Toads were heard calling, captured and/or photographed. A return trip to the region in 1996 revealed at least one Fowler's Toad along the same road. A volunteer crew from Bonnyvale Environmental Education Center in Brattleboro was trained to survey for this species but again located it only from the Stebbins Road area. Patti Smith of Bonnyvale found or heard about eight Fowler's Toads (could include duplicates) from the Stebbins Road area in July of 2002. She taped a breeding chorus from along the edge of the Connecticut River near the north end of Stebbin's Road. That same year, a surprisingly disjunct report came from one of the same naturalists who first reported the White River Junction Fowler's toads back in 1983 (Michael Caduto). He reported hearing calls from one spot along the Saxton's River in Rockingham. In 2003, Jim Andrews again did survey work in the region and found two toads along Stebbins Road despite a wider search. In 2004, Wendy Hardy (a student of Jim Andrews) did an extensive survey along the Connecticut River for this species from Rockingham south and west to Guilford. Again, Fowler's Toads were found only from the Stebbins Road area. She found the species four times between July and October of that year and took photographs to document the species. She and her husband boated the Connecticut in search of this species and found them calling from an island (technically NH) in the river adjacent to the Stebbin's Road area. Jim Andrews again found them from the same area in 2005 and Patti Smith found and photographed the last one seen in 2007. Despite the targeted and extensive efforts of graduate student Angela Michael in 2008 and brief but repeated visits by Jim Andrews, Patti Smith and other members of the Reptile and Amphibian Scientific Advisory Group to the Stebbin's Road area, to Allen Brothers Marsh, and to other potential habitat up and down the Connecticut River Valley south of Hartford, this species has not been located since the 2007 sighting.

Seven additional unverified and poorly documented reports from the Connecticut River drainage come from Baltimore, Guilford, Jamaica, Townshend, Vernon, and Weathersfield spanning the years from 2000 through 2009. The 2009 report from Vernon appears to be a hybrid between a Fowler's Toad and an American Toad (*Anaxyrus americanus*) and was found upstream only a short distance (< 0.5 miles) from the Stebbin's Road population.

Single unverified reports also exist from Middlebury, Sudbury, and Hartford, NY in the southern Lake Champlain basin. These span the years from 1983 through a 2008 report from Hartford, NY along Route 149 east of Fort Ann. Since none of these reports were documented with either photographs or tapes and were widely disjunct, they have not been included on maps but they could possibly represent populations.

13. Current Abundance (*Number of Breeding Individuals or Size of Area Occupied, Confidence in Records, Problems in Estimating Abundance, etc.*):

This species was last documented in 2007. This species is known to hybridize with American Toad (*A. americanus*) and some possible hybrids have been seen and heard in the southern Connecticut River Valley in the last few years; however, the current population of Fowler's Toads, if it exists at all, is small enough so that none have been located in the last five years.

14. Population Trend: / Estimate Based On:

Population Trend:	Estimate Based On:
__X__ Declining	__X__ Surveys
____ Stable	____ Counts
____ Increasing	__X__ Observations
____ Unknown	____ Other (*explain*) (see below)

Documentation & Comments:

Surveys for this species have targeted the Connecticut River Valley primarily south of Rockingham. Fortunately this species has a very distinctive and easily recognizable call. The Vermont Reptile and Amphibian Database contains over 70,000 reports from all corners of Vermont gathered by professional wildlife biologists and some very knowledgeable laypeople; however, no other documented reports for this species exist. All well-documented reports come from along the southern Connecticut River valley and in recent years, only from the Stebbin's Road area of Vernon.

According to the 2010 COSEWIC status report for this species, Fowler's Toad populations "fluctuate widely in abundance". At Long Point in Ontario, "their numbers have gone from dozens to hundreds of individuals and back over the 10 years from 1988 through 1997". In Ontario, their preferred habitat is "early stages of ecological succession in sand dune and lake-shore habitats". These habitats are inherently unstable and changing. Irregularly occurring severe storms both cause direct mortality and create new breeding habitat. Population viability analyses in Canada give the species a 20% chance of becoming extirpated from Canada in the next 100 years.

In the Ontario recovery strategy for this species (Green et al., 2011), they state that Fowler's Toads can repopulate areas after local extirpations "provided there are no barriers" since a small percentage (~2%) travel up to 8 miles from their place of birth. "Fowler's Toads repopulated Big Creek National Wildlife Area at Long Point in 1991 after an absence of a few years (Smith and Green, 2006).

We may be experiencing the depth of one of those cycles currently in Vermont. However, in Ontario those cycles began to rebound after a period of three years. It has been five years since we have seen the Vernon population and almost thirty years since we have seen the Hartford population. Given our inability to locate these populations in recent years and the distance to the nearest known populations (Gill, Massachusetts is roughly 10 miles south), we feel it is worthy of and would benefit from listing. Tom Tyning (Pers. comm. 2012) states that the species was still found in the Gill area in 2011. The most recently published data available are from Amherst in the mid 1990s (Jackson et al., 2010). Assuming the Gill population is still healthy, 4-6 years (two to three toad-generations) of optimal conditions might allow a population in the Gill area to recolonize the Vernon area if appropriate habitat is present here and along the way. However, this is based on the untested assumption that there are no insurmountable barriers to dispersal between Gill and Vernon. If small numbers of this species exist here or nearby, recolonization could occur sooner.

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(1) HABITAT IN VERMONT

15. General Description:

Fowler's Toads are tolerant of and dependent upon warmer temperatures then American Toads (Frost and Martin, 1971).

Along the north shore of Lake Erie all Fowler's Toad reports are within ½ kilometer of the shore and the toads require habitat in the early stages of ecological succession. At those sites they require five habitat types in close proximity to sustain a population (COSEWIC, 2010):

- Hibernation habitat (sandy dunes)
- Breeding, egg-laying habitat (sparsely vegetated still-water ponds, sandy bottom pools, shallow rocky shoals, or rocky pools)
- Feeding and hydration habitat (sandy riverside and lakeshore habitats with bare to sparse vegetation cover)
- Daytime retreat and aestivation habitat (sandy beaches and shoreline debris), and
- Dispersal corridor habitat.

Overwintering habitat is mentioned as a potential limiting factor in Canada (COSEWIC, 2010). Burrows must be deep enough for the toads to avoid freezing, close enough to the water table to be damp, but not so deep as to be flooded. Toads are not tolerant of freezing or of long-term submergence while over wintering.

Stille (1952) reported small home ranges with most toads emerging from the ground within 60-210 meters of the water's edge. In Canada (COSEWIC, 2010) Fowler's Toads (nocturnal) spend days buried in soil up to 400 m from the waters edge but they must move to the water as soon as they emerge to replace moisture lost while in the soil.

Along Lake Erie, Fowler's Toads depend upon breeding sites that are continually created or maintained by disturbance.

Breeding habitat in Vermont appears to be the disturbed margins of the Connecticut River and its tributaries in Windham and Windsor Counties, and perhaps shorelines of other water bodies near sandy soils in those floodplains. Terrestrial habitat appears to be largely open areas of adjacent floodplains and lower-elevation uplands within a few hundred meters of those breeding sites, particularly those with sandy or gravelly soils. This includes yard edges and moderately developed residential or agricultural areas. According to Klemens (1993) the species prefers well-drained sand and gravel habitat in Connecticut. Wright and Wright (1949) state "wherever Fowler's Toads are sympatric with American Toads (as they are anywhere in Vermont), Fowler's Toads occur in rivers, streams, or lake beaches" and American Toads in the uplands. This appears to be the case in Vermont. Soil maps show large deposits of sand in the Vernon area.

16. Habitat Losses in Past (*Amount and Location*):

Early successional habitat in sandy soils within 400 meters of the Connecticut River has probably been reduced significantly with the development of an extensive series of flood control dams in the Connecticut River drainage. In addition, sandy and gravelly soils in the floodplain have been desirable sites for shoreline development and agriculture. Some types of low-density development and agriculture (pasture, some crops, new farm ponds) may have created open early-successional foraging habitat or breeding habitat for this species; however, high-density development with heavy road traffic (toads suffer high road mortality), row crops and intensive pesticide or herbicide use (atrazine) are probably not consistent with continued Fowler's Toad use. Bank stabilization activities would also limit the amount of potential habitat for this species.

This floodplain area has also seen significant road building. Routes 91 and 5 both parallel the river within the floodplain on the Vermont side as well as numerous smaller roads such as 142 in Vernon.

17. Probable Habitat Losses in Future (*Amount, Location, and Type*):

The frequency and severity of floods in the future will likely be controlled as much as is possible with the extensive series of flood control dams in the Connecticut River drainage. This will continue to limit the creation and maintenance of the early successional habitat required by this species.

Although it seems unlikely that there will be many new roads built within 400 m of the Connecticut River and its major tributaries, traffic on the many roads already existing within these zones will continue to increase.

The area between Stebbins Road and the Connecticut River is currently changing from small scale farming with scattered seasonal camps to permanent homes. The area west of Stebbins Road and Route 142 has some large tract developments already in place. Traffic on area roads continues to increase.

According to VTrans (Chris Slesar pers. comm., 2011) the frequency of what once were considered one-hundred-year floods has increased over the last decade. In the future, these may produce appropriate habitat in larger tributaries of the Connecticut River without flood control dams.

18. Current Protected Status of Habitat:

___ Unknown Whether Any Protected
_X_ Believed To Be None Protected
____ At Least One Protected Occurrence
___ Several Protected Occurrences
___ Many Protected Occurrences
_X_ Other (*explain*) There are state-owned lands west of Route 142 but we have no historic or current records of Fowler's in those areas despite herpetological surveys on those lands.

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(2) POPULATION BIOLOGY

19. Population Threats (*Contaminants, Predation, Competition, Disease, Human Disturbance from Recreation, Collection,*
Harvest, etc.)

Degree of Threat:

_X_ Very Threatened, Species Directly Exploited or Threatened by Natural or Man-caused Forces
___ Moderately Threatened, Habitat Lends Itself to Alternate Use but is not Currently in Jeopardy
___ Little Threat, Self-protecting by Unsuitability for Other Uses
___ Unknown

Documentation & Comments:

Since this species has not been documented in Vermont since 2007, there are clearly factors or combinations of factors that occur (or did occur) that render it vulnerable to extirpation. However, it is unclear exactly what factors or combination of factors brought about the current situation. As noted above, this species regularly undergoes large population changes. If the population has dropped to zero, the existence of nearby healthy populations to recolonize previously occupied areas is essential. In addition, the colonizers within those populations need to be able to safely traverse the landscape along the river for some distance as populations rebuild. Given distances between populations that may be larger than the dispersal range of juvenile toads, all five required habitat types will need to be located fairly regularly (~every 8 miles) along the shore of the Connecticut River in order for recolonization to take place from a distant source. Impediments to travel exist in increased road traffic, more intensive or chemical dependent agricultural methods, and intensive development such as in the towns along the river.

According to Freda and Dunson (1986) this species shows decreased larval growth rates with increased acidity (lowered pH) due to acid rain. It is also less tolerant than most amphibians to atrazine (Birge et al., 2000), and is particularly sensitive to the insecticide azinphos-methol (Guthion; Mayer and Ellersieck, 1986). The organochlorides endrin, toxaphene, dieldrin, toxaphene, DDT, and lindane are also highly toxic to larval Fowler's Toads (Sanders, 1970). Adults were also highly sensitive to organochlorides (Ferguson and Gilbert, 1968) as well as pyrethroid insecticides (Bennett et al., 1983) and the metals chromium, gallium, titanium, and aluminum (Birge et al., 2000). In southwestern Ontario, agricultural chemicals were listed as a possible contributing factor to Fowler's Toads declines. The herbicide Trifluralin and the insecticide Endrin were reported to be particularly toxic to toads (COSEWIC, 2010). The disappearance of Fowler's Toads from many of the Massachusetts islands was thought to be the result of DDT use according to Lazell (1976). DDT is also suspected of eliminating populations on Point Pelee in Canada (COSEWIC, 2010). We have not looked at the available data on the level of any of these substances in the Connecticut River or on surrounding lands, although we expect atrazine is widely used on corn crops along the Connecticut River.

Fowler's Toads are susceptible to mycobacterial (Shively et al., 1981) and parasitic infections (Jilek and Wolff, 1978; Ashton and Rabalais, 1978; McAllister et al., 1989; and Vences et al., 2003). Botulism is also considered a potential threat to Fowler's Toads (COSEWIC, 2010). Along the north shore of Lake Erie is was noticed that shoreline mats of algae created the anaerobic conditions that allow *Clostridium botulinum* to survive.

20. Tolerance To Human Activity:

___ Fragile
_X_ Fairly Resistant
___ Tough
____Unknown

Documentation & Comments:

Fowler's Toads were reported from a residential area of White River Junction and were regularly found along and near Stebbins Road in Vernon. Historic clearing near the Connecticut River may have added to the open areas that this species frequently uses. Historically, frequent flooding as a result of over harvesting of trees may also have created more of the soil deposits and open pools along rivers that this species requires. However, flood control, chemical use, tilling, increased traffic, migration barriers, and intensive development may have limited available habitat for Fowler's Toads, their access to it, and or their ability to survive in it.

Toads overwinter and avoid predation and desiccation during the day and during dry periods by digging into sandy or loose soil (Harding and Holman, 1992). By the end of the winter they have burrowed to depths of up to 15-30 cm (R. Latham quoted in Oliver, 1955). Tilling of the soil in late fall or early spring may disturb or kill overwintering Fowler's Toads. Tilling during other times of the year could have the same impact on toads underground for the daytime hours or when aestivating to escape dehydration.

21. Reproduction Parameters (*Age to Sexual Maturity, Annual Production of Offspring, Reproductive Life, or Other Factors that Warrant Consideration*):

Fowler's Toads have a reported maximum life expectancy of five years in the wild (Kellner and Green, 1995), with most adult toads living to three years of age. Clarke (1977) reports a 22.5% annual survival rate after metamorphosis. However, both males and females reach reproductive age at an average age of two years (Breden, 1987) and females can produce up to 8000 eggs in a single breeding event (Wright and Wright, 1995). Survivorship from egg to adult is roughly 1 in 1,430 eggs (Clarke, 1977).

22. Reproductive Status: *Documentation & Comments*:

___ Reproduces in Vermont
- ____Confirmed In Last 2 Years
- _X_ Confirmed In Last 10 Years
- ___ Confirmed In Last 25 Years
- ___ Confirmed Prior To 25 Years Ago
- ___ Unconfirmed

___ Does Not Breed or is Migratory

Documentation & Comments:

Singing male Fowler's Toads were heard in 2002 in Vernon and Rockingham and in 2004 in Vernon. However, we have no evidence of the success of those breeding attempts. Since Fowler's Toad have a limited life span in the wild (maximum of five years, Kellner and Green, 1995) and were seen in 2007 they must have reproduced in the last decade.

23. Additional Study or Documentation Needed:

Annual surveys along the Connecticut River in both Windham and Windsor Counties on warm wet nights from June through July (timing based on Andrews, 2011A; The Vermont Reptile and Amphibian Atlas Database).

24. Attachments:
- 24.1 List of literature cited or other references
- 24.2 Map of worldwide distribution (IUCN, 2012)
- 24.3 Map of statewide distribution (Andrews, 2011)
- 24.4 Map of Fowler's Toad observations in southeastern VT (Andrews and Briggs, 2012)
- 24.5 Amphibian abundance chart (Andrews, 2012)
- 24.6 Narrative summary

25. Scientific Subcommittee Chairman: Date:

James S. Andrews

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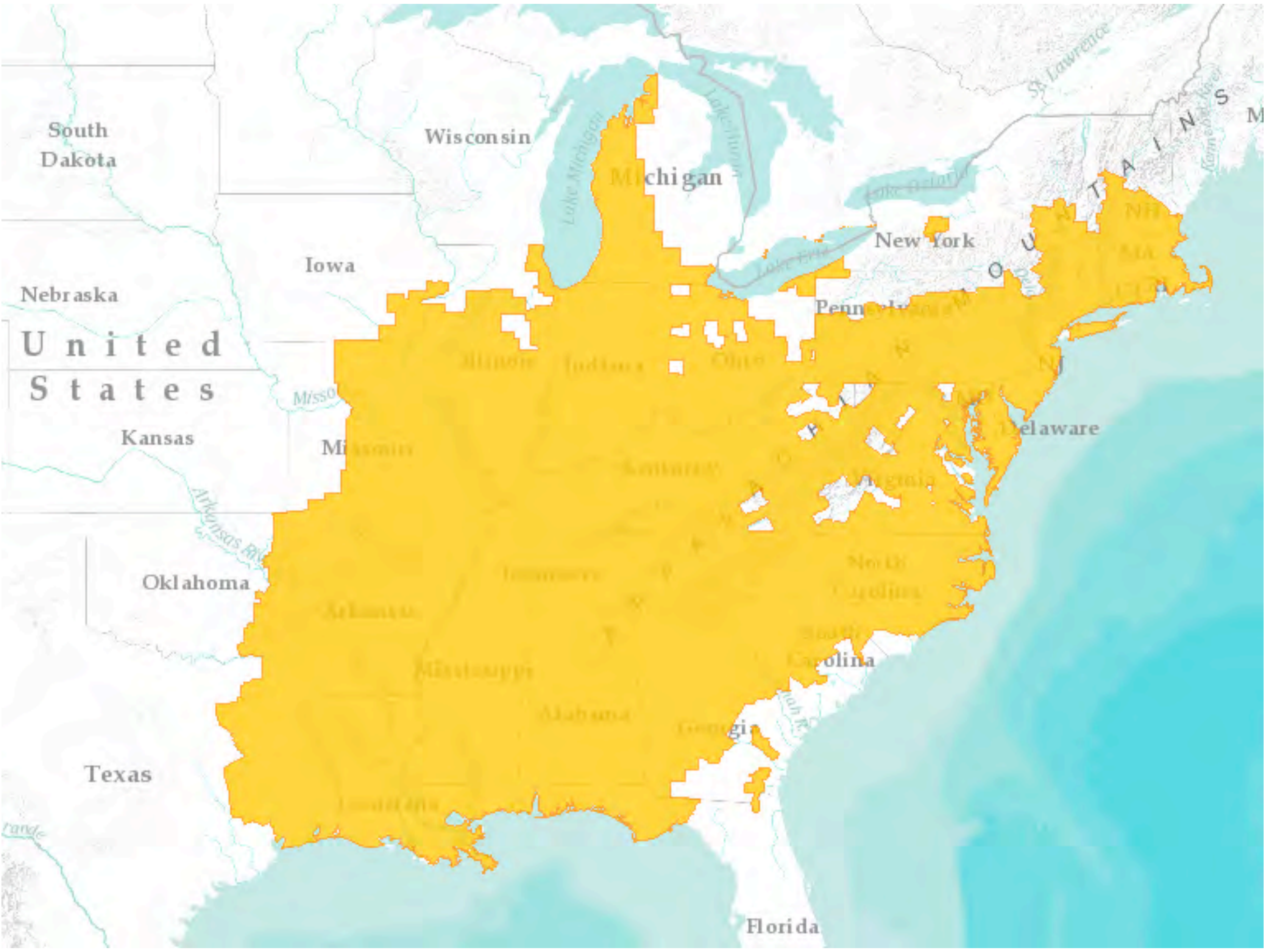
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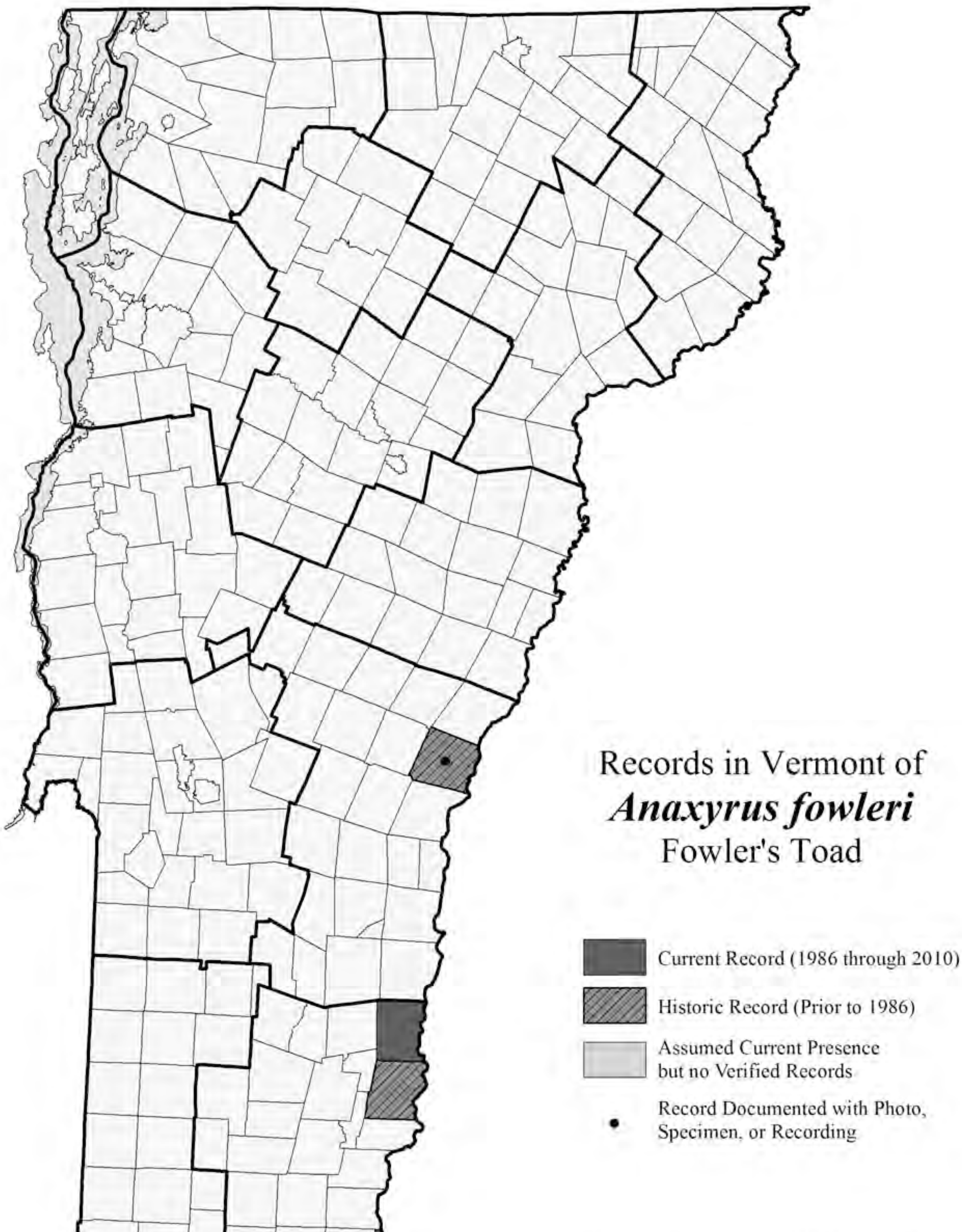

Note: The most recent verified report of this species in Vermont was in 2007.

All Fowler's Toad Observations in Southeastern Vermont including unverified (?) reports

Vermont Amphibian Records
January 1, 1987 to December 31, 2011

Jim Andrews, Elizabeth Volpe, & Erin Talmage

These tables give a rough idea of the relative abundance and distribution of Vermont's herptiles. The comparisons are subject to bias by the audibility, visibility, notoriety, and ease of identification of species. For example, since salamanders don't call and are usually under cover, they are reported less often than frogs. Consequently, the species are sorted by taxonomic group so that some of these biases are alleviated. However, some other biases remain. For instance, Eastern Ribbonsnakes when observed may be assumed to be Common Gartersnakes and hence they may be under-reported. Aquatic species of turtle that bask only infrequently are probably reported less often than terrestrial or basking species. Still, these tables help the Scientific Advisory Group decide if the state rank and/or state status of a species needs to be reevaluated. Species are listed in descending order of the number of "sites" from which they have been reported. Errors in the number of known sites and towns for the more abundant species are almost certainly included and those numbers are changing monthly. There are a total of 255 "towns" (political units including towns, cities, gores, and unincorporated areas) in the state of Vermont.

Salamanders

Species	# of towns	# of sites	State Rank	State Status	Site Size	SGCN Priority
Eastern Newt	221	1151	S5		0.5km	
Spotted Salamander	218	861	S5		0.5km	Medium
Eastern Red-backed Salamander	239	777	S5		0.5km	
Northern Two-lined Salamander	216	557	S5		0.5km	
Northern Dusky Salamander	191	413	S5		0.5km	
Spring Salamander	102	181	S4		0.5km	
Blue-spotted Salamander Group	57	175	S3	SC	0.5km	Medium
Jefferson Salamander Group	54	94	S2	SC	0.5km	High
Mudpuppy	26	38	S2	SC	0.5km	High
Four-toed Salamander	21	26	S2	SC	0.5km	Medium

Frogs

Species	# of towns	# of sites	State Rank	State Status	Site Size	SGCN Status	Notes
Green Frog	253	1373	S5		0.5km		
Wood Frog	257	1170	S5		0.5km		
Spring Peeper	234	1042	S5		0.5km		
American Toad	250	1002	S5		0.5km		
Gray Treefrog	163	519	S5		0.5km		
Pickerel Frog	175	456	S5		0.5km		
American Bullfrog	170	423	S5		0.5km		
Northern Leopard Frog	74	357	S4		0.5km		
Mink Frog	43	75	S3		0.5km		
Fowler's Toad	2	2	S1	SC	0.5km	High	Missing since 2007
Boreal Chorus Frog	1	1	S1	E	0.5km	High	Missing since 1999

VERMONT

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Agency of Commerce and Community Development

March 1, 2013

Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, D.C. 20426

Re: Vermont SHPO Comments and Study Requests in Response to the Pre-Application Documents and Scoping Document 1 for the Wilder (FERC No. 1892-026), Bellows Falls (FERC No. 1855-045), and Vernon (FERC No. 1904-073) Hydroelectric Projects, TransCanada Hydro Northeast, Inc.

Dear Secretary Bose:

Thank you for the opportunity to comment on the above referenced project. The following comments will assist the Federal Energy Regulatory Commission (FERC) in their review responsibilities under Section 106 of the National Historic Preservation Act.

The Vermont Division for Historic Preservation (Division) is providing the FERC with the following comments pursuant to 36 CFR 800.4, regulations established by the Advisory Council on Historic Preservation to implement Section 106 of the National Historic Preservation Act. Project review consists of assisting FERC in identifying the project's potential impacts to historic buildings, structures, historic districts, historic landscapes and settings, and known or potential archeological resources that are listed in or may be eligible for inclusion in the National Register of Historic Places (National Register).

The focus of these comments concerns the process articulated in the combined Pre-Application Documents (PADs) for conducting and completing archeological studies within the Wilder, Bellows Falls, and Vernon (Projects) boundaries. The Division also notes that only one of the three Phase IA studies that form the basis for archeological site discussion in the PADs, the *Phase IA Archaeological Reconnaissance Survey Vernon Hydroelectric Project (FERC No. 1904)* compiled by the Public Archaeology Laboratory (PAL) in March 2008 has been submitted to the Division. The Division requests that the remaining two Phase IA studies for the Wilder and Bellows Falls projects, also produced by PAL, be submitted for review and comment as soon as possible as specified in PADs.

Based on the archeologically information summarized in the PADs, and in the Vernon Phase IA report, it is apparent that at least 67 archeological sites have been currently identified within the Project in Vermont and as many as 66 potential archeological sites, identified by archival research, may be also be present. Two of the known sites are listed on the National Register and three additional sites have been determined to be eligible for the National Register as the result of prior studies. At the current level of documentation, these sites are the only below ground historic properties subject to protection under the National Historic Preservation Act.

The above high incidence of site encounter, which was based predominantly on visual inspection of the shoreline carried out from a boat augmented by land based spot-checks as well as terrestrial walkover of upland parcels owned by TransCanada, clearly reflects the correspondingly high degree of archeological sensitivity of much of the Project Area of Potential Effect (APE). Although the high degree of archeological sensitivity is noted, the PADs do not contain specific proposals to conduct Phase IB site identification studies or Phase II site evaluation studies to determine eligibility beyond the Phase IA studies already completed. Instead, TransCanada generally proposes to institute a monitoring program targeted at select locations to identify shoreline changes at known sites or within archeologically sensitive areas. If project related changes are noted during the monitoring, then Phase IB site identification and, presumably, Phase II site evaluation procedures would be implemented as necessary. Any adverse effects would then be addressed by the development and implementation of a mitigation plan.

The Division does not support this approach, particularly with regard to the Wilder and Bellows Falls Projects, where PAL documented moderate to severe erosion along broad sections of the shoreline during the Phase IA studies. The 36 CFR 800 regulations require that historic properties within the APE be identified **before** effects resulting from project operation can be determined.

At issue here may be the delineation of the APE. Based on multiple comments throughout the PADs, TransCanada does not believe that Projects' operation plays more than a minor role in shoreline erosion. While the Division agrees with TransCanada's assertion that the Projects' operation is not solely responsible for shoreline erosion, the Projects' effect on the destabilization of the riverbank is sufficient to bring all terrace margins and adjacent areas within the APE.

The results of the March 2008 Phase IA study for the Vernon Project were incorporated in the October 2008 Historic Properties Management Plan (Vernon HPMP). Integral to the Vernon HPMP was the establishment of a monitoring program focused on all known and potential archeological sites as well as archeologically sensitive areas identified in the Phase IA study. While the Division has similar concerns for the necessity of conducting site identification and evaluation procedures in Vernon as discussed above for Wilder and Bellows Falls, the Vernon monitoring program is scheduled to begin in 2013. Given this immediacy, the Division will provide more detailed comments once the 2013 monitoring study report is filed. As outlined below, any recommended Phase IB and Phase II site evaluation studies will be focused in site or sensitive areas undergoing active erosion or other project related disturbance.

Based on the above considerations, the Division requests that the Licensee complete the following studies:

<u>Wilder and Bellows Falls Projects</u>

- Phase IB site identification within all archeologically sensitive areas and potential site locations that are actively eroding.
- Phase II site evaluation of all currently recorded archeological sites in the Project APE to determine their boundaries and eligibility for inclusion the National Register of Historic Places.

- Phase II site evaluation of any other archeological site identified in the Project APE as a result of the Phase IB survey to determine their boundaries and eligibility for inclusion in the National Register of Historic Places.

Wilder Project

- National Register Evaluation Report for the Wilder Project Hydroelectric Components

Vernon Project

- Phase IB site identification within all archeological sensitive areas and potential site locations that are actively eroding based on the 2013 Monitoring Report.

- Phase II site evaluation of all known archeological sites in the Project APE to determine their boundaries and eligibility for inclusion in the National Register of Historic Places.

The above studies will contribute to the development/revision of the Project specific HPMP's and Mitigation Plans for all historic properties determined to be eligible for the National Register of Historic Places, in addition to informing one or more Programmatic Agreements for the overall Project. Completion of these actions will ensure that the Project relicensing fully considers potential impacts to historic properties in compliance with the National Historic Preservation Act.

Thank you for your cooperation in protecting Vermont's irreplaceable historic and archeological heritage. R. Scott Dillon reviewed this project and prepared this letter. I concur with the findings and conclusions described above.

Sincerely:
VERMONT DIVISION FOR HISTORIC PRESERVATION

Noelle MacKay (Commissioner, DEHCD) for.

Giovanna Peebles
State Historic Preservation Officer

Cc: John Ragonese, TransCanada
Elizabeth Muzzey, NH SHPO
Dick Boisvert, NH SHPO
Ed Bell, MA SHPO

TRANSCANADA HYDRO NORTHEAST INC.

Wilder Hydroelectric Project (FERC Project No. 1892-026)
Bellows Falls Hydroelectric Project (FERC Project No. 1855-045)
Vernon Hydroelectric Project (FERC Project No. 1904-073)

Revised Study Plan

Appendix B

Study Request Response Summary

Previously filed with the FERC on April 16, 2013

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Introduction

On October 31, 2012, TransCanada Hydro Northeast Inc. (TransCanada) filed with the Federal Energy Regulatory Commission (Commission or FERC), Notices of Intent to file applications for new licenses for the existing Wilder Hydroelectric Project (FERC Project No. 1892-026); Bellows Falls Hydroelectric Project (FERC Project No. 1855-045); and Vernon Hydroelectric Project (FERC Project No. 1904-073) (Projects) in accordance with 18 C.F.R. § 5.5. The current license for each project expires on April 30, 2018. TransCanada is using FERC's Integrated Licensing Process (ILP) as set forth in Title 18 of the US Code of Federal Regulations (C.F.R.), Part 5 to relicense the three Projects.

Simultaneous to filing of the NOIs, TransCanada filed Pre-Application Documents (PADs) for each of the three projects. The PADs provided FERC and interested parties with summaries of existing, relevant, and reasonably available information that was in TransCanada's possession as supplemented by a due diligence search of other sources of information about the projects and related environmental resources.

On December 21, 2012, the Commission issued its Scoping Document 1 (SD1) for the projects, and in January 2013 several public scoping meetings were held for interested parties to provide comments on the project PADs, to provide comments and suggestions to the Commission on the SD1, and to identify any resource studies that would help provide a framework for collecting pertinent information on the resource areas under consideration necessary for the Commission to prepare the Environmental Impact Statements (EISs) for the projects.

TransCanada received a total of 245 individual study requests related to the Wilder, Bellows Falls, and Vernon Projects in 23 letters from entities and individuals that were filed with or requested by the Commission on or before March 1, 2013. Additional comments without formal study requests were received from another 21 interested parties, but those are not addressed in this responsiveness summary. This document summarizes each individual study request (by requester) and TransCanada's response.

Some study requests did not meet one or more of the seven Integrated Licensing Process (ILP) study request criteria (18 C.F.R. § 5.9(b)) in substantive ways and have been excluded from the PSP on that basis. In such cases, our response indicates which of the seven ILP study plan criteria (18 C.F.R. § 5.9(b)(1)-(7)) that the request failed to meet.

Study requests that have been incorporated into study plans are identified in the tables that follow and are addressed in more detail in TransCanada's Proposed Study Plan (PSP) being filed simultaneously with the Commission. The following table identifies the acronyms used for study requesters in their respective responsiveness tables and throughout the PSP.

Request Submittal Authors	**Acronym Used in the PSP**
Appalachian Mountain Club, Vermont River Conservancy, and Friends of the Connecticut River Paddler's Trail	AMC-VRC-FRs
City of Lebanon, New Hampshire Planning Office	Leb
Connecticut River Joint Commissions	CRJC
Connecticut River Watershed Council	CRWC
Federal Energy Regulatory Commission	FERC
Lipfert, F. William, Jr. and Jennifer Lipfert	Lipfert
Mudge, John T. B.	Mudge
National Park Service	NPS
New England Flow and American Whitewater	NEF-AW
New England Flow, American Whitewater and Appalachian Mountain Club	NEF-AW-AMC
New Hampshire Department of Environmental Services	NHDES
New Hampshire Fish and Game Department	NHFG
New Hampshire Natural Heritage Bureau	NHNHB
The Nature Conservancy	TNC
The Nolumbeka Project	Nolumb
Town of Lyme, New Hampshire, City of Lebanon, New Hampshire, and O. Ross McIntyre	Lyme-Leb-McInt

Request Submittal Authors	**Acronym Used in the PSP**
Town of Rockingham, Vermont Conservation Commission	Rock
Trout Unlimited, Deerfield River Chapter	TU
Trustees of Pine Park Association, Hanover New Hampshire	Han
Two Rivers-Ottauquechee Regional Commission	TwoRiv
US Fish and Wildlife Service	FWS
Vermont Agency of Natural Resources	VANR
Vermont State Historical Preservation Office	VTSHPO

Appalachian Mountain Club, Vermont River Conservancy, and Friends of the Connecticut River Paddlers' Trail

Date of Letter: 2/28/2013. Three letters were filed, one for each project.

Study Request No.	Project	AMC-VRC-FRs Study Request	Response
1	Wilder, Bellows Falls, Vernon	Study of Project Facilities to Support Multiple-day Self-Powered Boating Trips on the CT River	Addressed in Study Plan No. 30
2	Wilder	Controlled Whitewater Flow Study for the Sumner Falls Reach	Addressed in Study Plan No. 31
2	Bellows Falls	Controlled Whitewater Flow Study in the Bypass Reach below the Bellows Falls Dam	Addressed in Study Plan No. 31
2	Vernon	Study of the Proper Presentation and Preservation of Important Historical Resources	TransCanada has not developed a study plan for this request. This is a mitigation request for an educational program (materials, kiosk, etc.) at the site, and preservation of historical records of the site that TransCanada might have. TransCanada considers this to be a request for a specific mitigation measure associated with historic resources more typical of what would be found in a Programmatic Agreement or Management Plan for Historic Resources, rather than a study request. Since this study request would not inform measures that could be considered for a new license it does not meet FERC study criteria 6.
3	Wilder		
4	Bellows Falls		

Study Request No.	Project	AMC-VRC-FRs Study Request	Response
3	Bellows Falls	Study of the Potential to Create a Whitewater Park in the Bellow Falls Bypass Reach	TransCanada has not developed a study plan for this request. This is a mitigation request for a specific recreational enhancement - a white water park. A suitability analysis must be completed to determine the suitability and capability for white water recreation in the Bellows Falls bypass. Boating fatalities have occurred in the past in this reach and therefore a thorough analysis must be undertaken prior to any recommended mitigation or proposal. However, preliminary analysis is included in Study Plan 31. In addition, multiple agencies have requested aquatic habitat assessments and fish passage studies that also encompass this reach. All of which requires a thorough analysis of all resources affected and suitability prior to considering this as a reasonable component in an overall project mitigation strategy.
3	Vernon	Study of the Economic Health of Ownership and Creation of a Decommissioning or Trust Fund	TransCanada has not developed a study plan for this request. This issue will be addressed in the economic analysis and amortization requirement in each Project License. Existing information available to FERC is sufficient to address this issue. Consequently this request does not meet FERC study criteria 4.
4	Wilder		
5	Bellows Falls		

City of Lebanon, New Hampshire Planning Office

Date of Letter: Received by FERC on 2/25/2013

The City of Lebanon referenced 18 CFR § 5.9(b) the ILP Study Plan Criteria in the header of its letter to FERC regarding relicensing of the Wilder Project. However, the letter included only comments on the Wilder PAD, and no study requests as defined by 18 CFR § 5.9(b).

Connecticut River Joint Commissions, Inc.

Date of Letter: 3/1/2013

Study Request No.	Project	CRJC Study Request	Response
1	Wilder, Bellows Falls, Vernon	Study Request for Watershed-wide Storm water Model	The primary issues relative to the TransCanada projects, for which this study request is proposed, are being addressed through methods similar to those requested but within a more limited geographic scope than proposed in this request . Developing a model for the entire Connecticut River watershed would be beyond the defined geographic scope of the projects and would be cost prohibitive (FERC study criteria 7). See Study Plan Nos. 4, 5, 7, 9, 27, 30, 33

Connecticut River Watershed Council

Date of Letter: 3/1/2013

Study Request No.	Project	CRWC Study Request	Response
1	Wilder	Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations for Wilder Dam	Addressed in Study Plan Nos. 2 and 3
2	Bellows Falls	Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations for Bellows Falls Dam	Addressed in Study Plan Nos. 2 and 3
3	Vernon	Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations for Vernon Dam	Addressed in Study Plan Nos. 2 and 3
4	Wilder, Bellows Falls, Vernon	Climate Change as it Relates to Continued Operation of the Vernon, Bellows Falls, Wilder, Northfield Mountain Pumped Storage, and Turners Falls Projects	TransCanada does not propose to develop a specific study plan that addresses climate change as it relates to project operations. Such a study would not necessarily inform potential mitigation measures (FERC study criteria 4) and would be cost prohibitive (FERC study criteria 7). Potential operational measures that could be considered will be informed by the water level and project operations modeling (Study Plan 4 and 5, and water quality monitoring (Study plan 6).

Study Request No.	Project	CRWC Study Request	Response
5	Wilder	Continuous water temperature monitoring (25 minute intervals) at various locations within the Wilder Hydroelectric Project Impoundment and Tailrace, and Connecticut River downstream of the Wilder Dam	Addressed in Study Plan No. 6
6	Bellows Falls	Continuous water temperature monitoring (25 minute intervals) at various locations within the Bellows Falls Hydroelectric Project Impoundment and Tailrace, and Connecticut River downstream of the Bellows Falls Dam	Addressed in Study Plan No. 6
7	Vernon	Continuous water temperature monitoring (25 minute intervals) at various locations within the Vernon Hydroelectric Project Impoundment and Tailrace, and Connecticut River downstream of the Vernon Dam	Addressed in Study Plan No. 6
8	Wilder	Water quality monitoring within the project impoundment and tailrace, Wilder Hydroelectric Project	Addressed in Study Plan No. 6
9	Bellows Falls	Water quality monitoring within the project impoundment and tailrace, Bellows Falls Hydroelectric Project	Addressed in Study Plan No. 6
10	Vernon	Water quality monitoring within the project impoundment and tailrace, Vernon Hydroelectric Project	Addressed in Study Plan No. 6
11	Wilder, Bellows Falls, Vernon	Model River Flows and Water Levels Upstream and Downstream from the Wilder, Bellows Falls, and Vernon Stations and Integration of Project Modeling with Downstream Project Operations	Addressed in Study Plan Nos. 4 and 5

Study Request No.	Project	CRWC Study Request	Response
12	Bellows Falls	Bellows Falls Bypass Flow (aquatic resources)	Addressed in Study Plan No. 9
13	Wilder, Bellows Falls, Vernon	Channel Morphology and Benthic Habitat Impacts at the Vernon, Bellows Falls and Wilder Projects	Addressed in Study Plan No. 8
14	Wilder, Bellows Falls, Vernon	In-stream Flow Habitat Assessment Downstream of Wilder, Bellows Falls, and Vernon Dams	Addressed in Study Plan No. 9
15	Wilder, Bellows Falls, Vernon	Determine the Fish Assemblage in Vernon, Bellows Falls and Wilder Project-Affected Areas	Addressed in Study Plan No. 10
16	Wilder, Bellows Falls, Vernon	Impacts of Water Level Fluctuations on Aquatic Vegetation, Including Invasive Species, in the Vernon, Bellows Falls and Wilder Project Impoundments and Riverine Reaches	Addressed in Study Plan Nos. 27 and 29
17	Wilder, Bellows Falls, Vernon	Impacts of the Vernon, Bellows Falls and Wilder Project Impoundment Water Fluctuations on Resident Fish Spawning	Addressed in Study Plan No. 14
18	Wilder, Bellows Falls, Vernon	Impacts of Water Fluctuations Downstream of the Vernon, Bellows Falls and Wilder Projects on Resident Fish Spawning	Addressed in Study Plan No. 15
19	Wilder, Bellows Falls, Vernon	Impacts of the Vernon, Bellows Falls and Wilder Project Operations on Tributary and Backwater Area Access and Habitats	Addressed in Study Plan No. 13

Study Request No.	Project	CRWC Study Request	Response
20	Wilder, Bellows Falls, Vernon	Determine Upstream Passage Needs for Riverine Fish Species in the Bellows Falls, Wilder and Vernon Fishways	Addressed in Study Plan No. 17
21	Wilder, Bellows Falls, Vernon	Shad Population Model for the Connecticut River	TransCanada did not develop a study plan for this request. For a number of reasons, TransCanada does not believe this is a reasonable request. The effects of the Vernon and Bellows Falls projects on the whole of the population of American shad in the Connecticut River is proportionally small given the other impacts shad experience in the river (e.g., entrainment at Mt. Tom and Vermont Yankee, and three dams below Vernon). The numerous American shad studies TransCanada is proposing will identify project-specific effects on American shad. The cost to create a shad population model for the Connecticut River compared to the effects of the projects on the resource is excessive (FERC study criteria 7).
22	Vernon	Telemetry Study of Upstream and Downstream Migrating Adult American Shad to Assess Passage Routes, Effectiveness, Delays, and Survival	Addressed in Study Plan No. 21

Study Request No.	Project	CRWC Study Request	Response
23	Bellows Falls, Vernon	Impact of Project Operations on Shad Spawning, Spawning Habitat, and Egg Deposition in the Project Areas of the Turners Falls, Northfield Mountain Pumped Storage and Vernon Project Areas and downstream from Bellows Falls Dam	Addressed in Study Plan No. 21
24	Vernon	Impact of Vernon Project Operations on Downstream Migration of Juvenile American Shad	Addressed in Study Plan No. 22
25	Wilder, Bellows Falls, Vernon	American Eel Survey Upstream of the Vernon, Bellows Falls, and Wilder dams	Addressed in Study Plan No. 11
26	Wilder, Bellows Falls, Vernon	Evaluation of Timing of Downstream Migratory Movements of American Eels on the Mainstem Connecticut River	Addressed in Study Plan No. 20
27	Wilder, Bellows Falls, Vernon	Upstream American Eel Passage Assessment at Vernon, Bellows Falls and Wilder Projects	Addressed in Study Plan No. 18
28	Wilder, Bellows Falls, Vernon	Downstream American Eel Passage Assessment at Vernon, Bellows Falls, and Wilder	Addressed in Study Plan No. 19
29	Wilder, Bellows Falls, Vernon	Assessment of Adult Sea Lamprey (*Petromyzon marinus*) Spawning within the Wilder, Bellows Falls, and Vernon Project Areas	Addressed in Study Plan No. 16
30	Wilder, Bellows Falls	Effects of the Wilder and Bellows Falls Projects on the Dwarf Wedgemussel (*Alasmidonta heterodon*)	Addressed in Study Plan No. 24

Study Request No.	Project	CRWC Study Request	Response
31	Wilder, Bellows Falls, Vernon	Project Effects on Populations of Tessellated Darter, *Etheostoma olmstedi*	Addressed in Study Plan No. 12

Federal Energy Regulatory Commission

Date of Letter: 3/1/2013

Study Request No.	Project	FERC Study Request	Response
1	Wilder, Bellows Falls, Vernon	Water Level Fluctuation Study	Addressed in Study Plan Nos. 4 and 5
2	Wilder, Bellows Falls, Vernon	River Bank Transect Study	Addressed in Study Plan No. 2
3	Wilder, Bellows Falls, Vernon	Historical River Bank Position and Erosion	Addressed in Study Plan No. 1
4	Wilder, Bellows Falls, Vernon	Riverbank Erosion Study	Addressed in Study Plan Nos. 2 and 3
5	Wilder, Bellows Falls, Vernon	Aquatic Habitat Mapping	Addressed in Study Plan No. 7
6	Wilder, Bellows Falls, Vernon	Aquatic Habitat Instream Flow Study	Addressed in Study Plan No. 9
7	Wilder, Bellows Falls, Vernon	Baseline Fisheries Population Study	Addressed in Study Plan No. 10
8	Wilder, Bellows Falls, Vernon	Assessment of Fish Impingement, Entrainment, and Survival Study	Addressed in Study Plan No. 23

Study Request No.	Project	FERC Study Request	Response
9	Bellows Falls, Vernon	American Shad Upstream Migration and Behavioral Study	Addressed in Study Plan No. 21
10	Wilder, Bellows Falls, Vernon	Recreation Facility Inventory and Use & Needs Assessment	Addressed in Study Plan No. 30
11	Bellows Falls	Whitewater Boating Flow Assessment	Addressed in Study Plan No. 31
12	Vernon	Vernon Project Cultural Resources Study	Addressed in Study Plan No. 33

Lipfert, F. William, Jr., and Jennifer Lipfert

Date of Letter: 3/1/2013

Study Request No.	Project	Lipfert Study Request	Response
1	Wilder	Evaluate the benefits of imposing a rate of change limitation in flow of 5,000 cfs per hour (or similar value) at Wilder.	This request does not meet the criteria for a study request under §5.9(b) in that it lacks sufficient detail to define how the study would be conducted or what data would be used (FERC study criterion 5 and 6). However, TransCanada will be performing several erosion studies and using hydraulic and operations models to assess project impacts including all contributing factors and assessment of potential mitigative factors as requested in this study request. See Study Plan Nos. 1 through 5

Mudge, John T. B.

Date of Letter: 2/27/2013

Study Request No.	Project	Mudge Study Request	Response
1	Wilder	Evaluate the effects of the operation of the Wilder Dam on the erosion of farmland along the Connecticut River	Addressed in Study Plan Nos. 2 and 3

National Park Service

Date of Letter: 2/28/2013

Study Request No.	Project	NPS Study Request	Response
1	Wilder, Bellows Falls, Vernon	Study of Project Facilities to Support Multiple-day Self-Powered Boating Trips on the Connecticut River	Addressed in Study Plan No. 30
2a	Bellows Falls	Controlled Whitewater Flow Study in the Bypass Reach Below the Bellows Falls Dam With Potential for Development of a Whitewater Park	Addressed in Study Plan No. 31
2b	Wilder	Controlled Whitewater Flow Study at Sumner Falls	Addressed in Study Plan No. 31

Study Request No.	Project	NPS Study Request	Response
3	Wilder, Bellows Falls, Vernon	Preservation of Cultural, Historical, and Educational Resources	TransCanada has not developed a study plan for this request. This is a mitigation request for an educational program (materials, kiosk, etc.) at the site, and preservation of historical records of the site that TransCanada might have. TransCanada considers this to be a request for a specific mitigation measure associated with historic resources more typical of what would be found in a Programmatic Agreement or Management Plan for Historic Resources, rather than a study request. Since this study request would not inform measures that could be considered for a new license it does not meet FERC study criteria 6.
4	Wilder, Bellows Falls, Vernon	Creation of a Decommissioning Fund	TransCanada has not developed a study plan for this request. This issue will be addressed in the economic analysis and amortization requirement in each Project License. Existing information available to FERC is sufficient to address this issue. Consequently this request does not meet FERC study criteria 4.

New England Flow and American Whitewater

Date of Letter: 3/1/2013 (two letters, one each for Wilder and Bellows Falls)

Study Request No.	Project	NEF-AW Study Request	Response
1	Wilder	We request a “Controlled Whitewater Flow Study” for the Sumner Falls Reach.	This request does not meet the criteria for a study request under §5.9(b). It lacks study methodology, level of effort and cost, and the nexus appears to be based on pre-Project conditions rather than the existing project. However, this study was requested by others following the study criteria and the concept will be addressed by Study Plan No. 31
2 3	Wilder Bellows Falls	We request a study of the adequacy of camping, sanitary and other facilities such as portages available for multiple-day kayaking or canoe trips.	This request does not meet the criteria for a study request under §5.9(b). It lacks study methodology, level of effort and cost, and the nexus appears to be based on pre-Project conditions rather than existing. However, this study was requested by others following the study criteria and the concept will be addressed by Study Plan No. 30
3 4	Wilder Bellows Falls	We request an economic analysis for the site recreation potential.	This request does not meet the criteria for a study request under §5.9(b). It lacks a level of effort and cost (FERC study criteria 7), and the nexus appears to be based on pre-Project conditions rather than existing Project operations (FERC study criteria 7).

Study Request No.	Project	NEF-AW Study Request	Response
4 5	Wilder Bellows Falls	Compensation for Impacts of Lost Whitewater Recreation.	This request does not meet the criteria for a study request under §5.9(b). It lacks study methodology (FERC study criteria 6), level of effort and cost (FERC study criteria 7), and the nexus appears to be based on pre-Project conditions rather than existing Project operations (FERC study criteria 5). Additionally, it is a request for mitigation.
1	Bellows Falls	We Request a Controlled Whitewater Flow Study in the bypass reach below the Bellows Falls Dam.	This request does not meet the criteria for a study request under §5.9(b). It lacks study methodology (FERC study criteria 6), level of effort and cost (FERC study criteria 7), and the nexus appears to be based on pre-Project conditions rather than existing Project operations (FERC study criteria 5). However, this study was requested by others following the study criteria and the concept will be addressed by Study Plan No. 31

Study Request No.	Project	NEF-AW Study Request	Response
2	Bellows Falls	We request a study to provide public Access for whitewater boating, rafting, and canoeing.	This request does not meet the criteria for a study request under §5.9(b). It lacks study methodology (FERC study criteria 6), level of effort and cost (FERC study criteria 7), and the nexus appears to be based on pre-Project conditions rather than existing Project operations (FERC study criteria 5). However, elements of this study were requested by others following the study criteria and the concept will be addressed by Study Plans No. 30 and 31.

New England Flow, American Whitewater, and Appalachian Mountain Club

Date of Letter: 2/28/2013 (three letters filed under one cover letter)

Study Request No.	Project	NEF-AW-AMC Study Request	Response
1	Wilder	Controlled Whitewater Flow Study for the Sumner Falls Reach	Addressed in Study Plan No. 31

Study Request No.	Project	NEF-AW-AMC Study Request	Response
1	Bellows Falls	Whitewater Park Feasibility Study	TransCanada has not developed a study plan for this request. This is a mitigation request for a specific recreational enhancement - a white water park. A suitability analysis must be completed to determine the suitability and capability for white water recreation in the Bellows Falls bypass. Boating fatalities have occurred in the past in this reach and therefore a thorough analysis must be undertaken prior to any recommended mitigation or proposal. However, preliminary analysis is included in Study Plan 31. In addition, multiple agencies have requested aquatic habitat assessments and fish passage studies that also encompass this reach. All of which requires a thorough analysis of all resources affected and suitability prior to considering this as a reasonable component in an overall project mitigation strategy.
1	Vernon	Mitigation for Impacts on the Connecticut River and Loss of Whitewater Recreation below each dam	TransCanada did not develop a study plan for this request. This is a request for mitigation based on pre-project conditions. The baseline for project impact analysis is the current projects and operations. Therefore, there is no nexus to the projects as licensed, FERC study criteria 5.
4	Wilder		
5	Bellows Falls		
2	Wilder	Camping, Sanitary and Other Facilities Such as Portages Available for Multiple-day	Addressed in Study Plan No. 30

Study Request No.	Project	NEF-AW-AMC Study Request	Response
2	Vernon	Kayaking or Canoe Trips	
3	Bellows Falls		
2	Bellows Falls	Public Access Study	Addressed in Study Plan No. 30
3	Wilder	Economic Impacts Assessment	TransCanada considers it premature to conduct a contingent valuation study pertaining to whitewater boating opportunities at Sumner Falls and the Bellows Falls bypassed reach until the potential whitewater boating opportunities are defined. TransCanada plans to do this by implementing Study Plan 31. The request for a contingent valuation study at Vernon is based on pre-project conditions. The baseline for project impact analysis is the current projects and operations. Therefore, there is no nexus to the projects as licensed, FERC study criteria 5.
3	Vernon		
4	Bellows Falls		

New Hampshire Department of Environmental Services

Date of Letter: 3/1/2013

Study Request No.	Project	NHDES Study Request	Response
1a	Wilder	Recreational Survey and Enhancement Study at Wilder Hydroelectric Project	Addressed in Study Plan No. 30

Study Request No.	Project	NHDES Study Request	Response
1b	Bellows Falls	Recreational Survey and Enhancement Study at Bellows Falls Hydroelectric Project	Addressed in Study Plan No. 30
1c	Vernon	Recreational Survey and Enhancement Study at Vernon Hydroelectric Project	Addressed in Study Plan No. 30
2	Wilder, Bellows Falls, Vernon	Telemetry Study of Upstream and Downstream Migrating Adult American Shad to Assess Passage Routes, Effectiveness, Delays, and Survival	Addressed in Study Plan No. 21
3	Wilder, Bellows Falls, Vernon	Evaluation of Timing of Downstream Migratory Movements of American Eels on the Mainstem Connecticut River	Addressed in Study Plan No. 20
4	Bellows Falls, Vernon	Impact of Project Operations on Shad Spawning, Spawning Habitat, and Egg Deposition in the Project Areas of the Turners Falls, Northfield Mountain Pumped Storage and Vernon Project Areas and downstream from Bellow Falls Dam	Addressed in Study Plan No. 21
5	Bellows Falls	Bellows Falls Bypass Flow (aquatic resources)	Addressed in Study Plan No. 9

Study Request No.	Project	NHDES Study Request	Response
6	Wilder, Bellows Falls, Vernon	Shad Population Model for the Connecticut River	TransCanada did not develop a study plan for this request. For a number of reasons, TransCanada does not believe this is a reasonable request. The effects of the Vernon and Bellows Falls projects on the whole of the population of American shad in the Connecticut River is proportionally small given the other impacts shad experience in the river (e.g., entrainment at Mt. Tom and Vermont Yankee, and three dams below Vernon). The numerous American shad studies TransCanada is proposing will identify project-specific effects on American shad. The cost to create a shad population model for the Connecticut River compared to the effects of the projects on the resource is excessive (FERC study criteria 7).
7	Wilder, Bellows Falls, Vernon	American Eel Survey Upstream of the Vernon, Bellows Falls, and Wilder Dams	Addressed in Study Plan No. 11
8	Wilder, Bellows Falls, Vernon	Channel Morphology and Benthic Habitat Impacts at the Vernon, Bellows Falls and Wilder Projects	Addressed in Study Plan No. 8
9	Wilder, Bellows Falls, Vernon	Downstream American Eel Passage Assessment at Vernon, Bellows Falls, and Wilder	Addressed in Study Plan No. 19

Study Request No.	Project	NHDES Study Request	Response
10	Wilder, Bellows Falls, Vernon	In-stream Flow Habitat Assessment Downstream of Wilder, Bellows Falls, and Vernon Dams	Addressed in Study Plan No. 9
12	Wilder, Bellows Falls, Vernon	Impacts of Water Fluctuations Downstream of the Vernon, Bellows Falls and Wilder Projects on Resident Fish Spawning	Addressed in Study Plan No. 15
12	Wilder, Bellows Falls	Effects of the Wilder and Bellows Falls Projects on the Dwarf Wedgemussel (*Alasmidonta heterodon*)	Addressed in Study Plan No. 24
13	Wilder, Bellows Falls, Vernon	Determine the Fish Assemblage in Vernon, Bellows Falls and Wilder Project-Affected Areas	Addressed in Study Plan No. 10
14a	Wilder, Bellows Falls, Vernon	Model River Flows and Water Levels Upstream and Downstream from the Wilder, Bellows Falls, Vernon, Turners Falls and Northfield Mountain Pump Storage Stations and Integration of Project Modeling with Downstream Project Operations	Addressed in Study Plan Nos. 4 and 5
15a	Wilder, Bellows Falls, Vernon	Impacts of Water Level Fluctuations on Riparian and Aquatic Vegetation, Including Invasive Species, in the Vernon, Bellows Falls and Wilder Project Impoundments and Riverine Reaches	Addressed in Study Plan Nos. 27 and 29
16	Wilder, Bellows Falls, Vernon	Impacts of the Vernon, Bellows Falls and Wilder Project Impoundment Water Fluctuations on Resident Fish Spawning	Addressed in Study Plan No. 14
17	Wilder, Bellows Falls, Vernon	Impacts of the Vernon, Bellows Falls and Wilder Project Operations on Tributary and Backwater Area Access and Habitats	Addressed in Study Plan No. 13

Study Request No.	Project	NHDES Study Request	Response
18	Wilder, Bellows Falls, Vernon	Impingement and Entrainment of Resident Fish Species at the Wilder, Bellows Falls and Vernon Intakes	Addressed in Study Plan No. 23
19	Wilder, Bellows Falls, Vernon	Assessment of Adult Sea Lamprey (*Petromyzon marinus*) Spawning within the Wilder, Bellows Falls, and Vernon Project Areas	Addressed in Study Plan No. 16
20	Wilder, Bellows Falls, Vernon	Determine Upstream Passage Needs for Riverine Fish Species in the Bellows Falls, Wilder and Vernon Fishways	Addressed in Study Plan No. 17
21a	Wilder	Wilder Hydroelectric Project: Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations	Addressed in Study Plan Nos. 2 and 3
21b	Bellows Falls	Bellows Falls Hydroelectric Project: Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations	Addressed in Study Plan Nos. 2 and 3
21c	Vernon	Vernon and Turners Falls Hydroelectric Projects: Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations in New Hampshire	Addressed in Study Plan Nos. 2 and 3
22a	Wilder	Continuous water temperature monitoring (25 minute intervals) at various locations within the Wilder Hydroelectric Project Impoundment and Tailrace, and Connecticut River downstream of the Wilder Dam	Addressed in Study Plan No. 6

Study Request No.	Project	NHDES Study Request	Response
22b	Bellows Falls	Continuous water temperature monitoring (25 minute intervals) at various locations within the Bellows Falls Hydroelectric Project Impoundment and Tailrace, and Connecticut River downstream of the Bellows Falls Dam	Addressed in Study Plan No. 6
22c	Vernon	Continuous water temperature monitoring (25 minute intervals) at various locations within the Vernon Hydroelectric Project Impoundment and Tailrace, and Connecticut River downstream of the Vernon Dam	Addressed in Study Plan No. 6
23	Wilder, Bellows Falls, Vernon	Project Effects on Populations of Tessellated Darter, *Etheostoma olmstedi*	Addressed in Study Plan No. 12
24	Wilder, Bellows Falls, Vernon	Upstream American Eel Passage Assessment at Vernon, Bellows Falls and Wilder Projects	Addressed in Study Plan No. 18
25a	Wilder	Wilder Hydroelectric Project: Water quality monitoring within the project impoundment and tailrace	Addressed in Study Plan No. 6
25b	Bellows Falls	Bellow Falls Hydroelectric Project: Water quality monitoring within the project impoundment, bypass, and tailrace	Addressed in Study Plan No. 6
25c	Vernon	Vernon Hydroelectric Project: Water quality monitoring within the Vernon project impoundment and tailrace and in the Turner Falls Impoundment in New Hampshire	Addressed in Study Plan No. 6
26	Vernon	Impact of Vernon Project Operations on Downstream Migration of Juvenile American Shad	Addressed in Study Plan No. 22

Study Request No.	Project	NHDES Study Request	Response
27	Wilder, Bellows Falls, Wilder	Climate Change as it Relates to Continued Operation of the Vernon, Bellows Falls, Wilder, Northfield Mountain Pumped Storage, and Turners Falls Projects	TransCanada does not propose to develop a specific study plan that addresses climate change as it relates to project operations. Such a study would not necessarily inform potential mitigation measures (FERC study criteria 4) and would be cost prohibitive (FERC study criteria 7). Potential operational measures that could be considered will be informed by the water level and project operations modeling (Study Plan 4 and 5, and water quality monitoring (Study plan 6).

New Hampshire Fish and Game Department

Date of Letter: 2/27/2013

Study Request No.	Project	NHFG Study Request	Response
1a	Wilder	Recreational Survey and Enhancement Study at Wilder Hydroelectric Project	Addressed in Study Plan No. 30
1b	Bellows Falls	Recreational Survey and Enhancement Study at Bellows Falls Hydroelectric Project	Addressed in Study Plan No. 30
1c	Vernon	Recreational Survey and Enhancement Study at Vernon Hydroelectric Project	Addressed in Study Plan No. 30

Study Request No.	Project	NHFG Study Request	Response
2	Vernon	Telemetry Study of Upstream and Downstream Migrating Adult American Shad to Assess Passage Routes, Effectiveness, Delays, and Survival	Addressed in Study Plan No. 21
3	Wilder, Bellows Falls, Vernon	Evaluation of Timing of Downstream Migratory Movements of American Eels on the Mainstem Connecticut River	Addressed in Study Plan No. 20
4	Vernon	Impact of Project Operations on Shad Spawning, Spawning Habitat, and Egg Deposition in the Project Areas of the Turners Falls, Northfield Mountain Pumped Storage and Vernon Project Areas and downstream from Bellow Falls Dam	Addressed in Study Plan No. 21
5	Bellows Falls	Bellows Falls Bypass Flow (aquatic resources)	Addressed in Study Plan No. 9

Study Request No.	Project	NHFG Study Request	Response
6	Wilder, Bellows Falls, Vernon	Shad Population Model for the Connecticut River	TransCanada did not develop a study plan for this request. For a number of reasons, TransCanada does not believe this is a reasonable request. The effects of the Vernon and Bellows Falls projects on the whole of the population of American shad in the Connecticut River is proportionally small given the other impacts shad experience in the river (e.g., entrainment at Mt. Tom and Vermont Yankee, and three dams below Vernon). The numerous American shad studies TransCanada is proposing will identify project-specific effects on American shad. The cost to create a shad population model for the Connecticut River compared to the effects of the projects on the resource is excessive (FERC study criteria 7).
7	Wilder, Bellows Falls, Vernon	American Eel Survey Upstream of the Vernon, Bellows Falls, and Wilder Dams	Addressed in Study Plan No. 11
8	Wilder, Bellows Falls, Vernon	Channel Morphology and Benthic Habitat Impacts at the Vernon, Bellows Falls and Wilder Projects	Addressed in Study Plan No. 8
9	Wilder, Bellows Falls, Vernon	Downstream American Eel Passage Assessment at Vernon, Bellows Falls, and Wilder	Addressed in Study Plan No. 19

Study Request No.	Project	NHFG Study Request	Response
10	Wilder, Bellows Falls, Vernon	In-stream Flow Habitat Assessment Downstream of Wilder, Bellows Falls, and Vernon Dams	Addressed in Study Plan No. 9
11	Wilder, Bellows Falls, Vernon	Impacts of Water Fluctuations Downstream of the Vernon, Bellows Falls and Wilder Projects on Resident Fish Spawning	Addressed in Study Plan No. 15
12	Wilder, Bellows Falls	Effects of the Wilder and Bellows Falls Projects on the Dwarf Wedgemussel (*Alasmidonta heterodon*)	Addressed in Study Plan No. 24
13	Wilder, Bellows Falls, Vernon	Determine the Fish Assemblage in Vernon, Bellows Falls and Wilder Project-Affected Areas	Addressed in Study Plan No. 10
14	Wilder, Bellows Falls, Vernon	Model River Flows and Water Levels Upstream and Downstream from the Wilder, Bellows Falls, and Vernon Stations and Integration of Project Modeling with Downstream Project Operations	Addressed in Study Plan Nos. 4 and 5
15	Wilder, Bellows Falls, Vernon	Impacts of Water Level Fluctuations on Aquatic Vegetation, Including Invasive Species, in the Vernon, Bellows Falls and Wilder Project Impoundments and Riverine Reaches	Addressed in Study Plan Nos. 27 and 29
16	Wilder, Bellows Falls, Vernon	Impacts of the Vernon, Bellows Falls and Wilder Project Impoundment Water Fluctuations on Resident Fish Spawning	Addressed in Study Plan No. 14
17	Wilder, Bellows Falls, Vernon	Impacts of the Vernon, Bellows Falls and Wilder Project Operations on Tributary and Backwater Area Access and Habitats	Addressed in Study Plan No. 13

Study Request No.	Project	NHFG Study Request	Response
18	Wilder, Bellows Falls, Vernon	Impingement and Entrainment of Resident Fish Species at the Wilder, Bellows Falls and Vernon Intakes	Addressed in Study Plan No. 23
19	Wilder, Bellows Falls, Vernon	Assessment of Adult Sea Lamprey (*Petromyzon marinus*) Spawning within the Wilder, Bellows Falls, and Vernon Project Areas	Addressed in Study Plan No. 16
20	Wilder, Bellows Falls, Vernon	Determine Upstream Passage Needs for Riverine Fish Species in the Bellows Falls, Wilder and Vernon Fishways	Addressed in Study Plan No. 17
21a	Wilder	Wilder Hydroelectric Project: Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations	Addressed in Study Plan Nos. 2 and 3
21b	Bellows Falls	Bellows Falls Hydroelectric Project: Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations	Addressed in Study Plan Nos. 2 and 3
21c	Vernon	Vernon Hydroelectric Project: Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations	Addressed in Study Plan Nos. 2 and 3
22a	Wilder	Continuous water temperature monitoring (25 minute intervals) at various locations within the Wilder Hydroelectric Project Impoundment and Tailrace, and Connecticut River downstream of the Wilder Dam	Addressed in Study Plan No. 6

Study Request No.	Project	NHFG Study Request	Response
22b	Bellows Falls	Continuous water temperature monitoring (25 minute intervals) at various locations within the Bellows Falls Hydroelectric Project Impoundment and Tailrace, and Connecticut River downstream of the Bellows Falls Dam	Addressed in Study Plan No. 6
22c	Vernon	Continuous water temperature monitoring (25 minute intervals) at various locations within the Vernon Hydroelectric Project Impoundment and Tailrace, and Connecticut River downstream of the Vernon Dam	Addressed in Study Plan No. 6
23	Wilder, Bellows Falls, Vernon	Project Effects on Populations of Tessellated Darter, *Etheostoma olmstedi*	Addressed in Study Plan No. 12
24	Wilder, Bellows Falls, Vernon	Upstream American Eel Passage Assessment at Vernon, Bellows Falls and Wilder Projects	Addressed in Study Plan No. 18
25a	Wilder	Wilder Hydroelectric Project: Water quality monitoring within the project impoundment and tailrace	Addressed in Study Plan No. 6
25b	Bellows Falls	Bellow Falls Hydroelectric Project: Water quality monitoring within the project impoundment, bypass, and tailrace	Addressed in Study Plan No. 6
25c	Vernon	Vernon Hydroelectric Project: Water quality monitoring within the project impoundment and tailrace	Addressed in Study Plan No. 6
26	Vernon	Impact of Vernon Project Operations on Downstream Migration of Juvenile American Shad	Addressed in Study Plan No. 22

New Hampshire Natural Heritage Bureau

Date of Letter: 2/27/2013

Study Request No.	Project	NHNHB Study Request	Response
Appendix A	Wilder, Bellows Falls, Vernon	Impacts of Water Level Fluctuation in Project Impoundments on Wetlands	Addressed in Study Plan Nos. 27 and 29
Appendix B	Wilder, Bellows Falls, Vernon	Establishment of Permanent Plots to Assess the Impacts of Ongoing Operations on Floodplain Forest Communities	TransCanada has not developed a study plan for this request. The purpose of this request is to identify long term trends in changes to floodplain forests. Therefore, this is a mitigation request and hence there is no nexus to the projects as licensed, and the request does not meet FERC study criteria 5. Further, since this study request would not inform measures that could be considered for a new license it does not meet FERC study criteria 6. However, an assessment of current project effects on floodplain forests is included in Study Plan No. 27.
Appendix C	Wilder	River Levels Relative to Jesup's Milk-Vetch Populations	Based on comments from the New Hampshire Natural Heritage Bureau (NHNHB), the Jesup's milk vetch study conducted in 2012 and provided to NHNHB for review addresses the concerns of this study request. That report will be filed with FERC by April 30, 2013.

Study Request No.	Project	NHNHB Study Request	Response
Appendix D	Wilder, Bellows Falls, Vernon	River Levels Relative to RTE Plant Species and Exemplary Natural Communities	TransCanada has not developed a study plan for this request as we believe we have completed a study that addresses this request. In its PAD comments, NHNHB noted that from Section 3.9.1: "The RTE project area does not include areas affected by dam releases form Wilder…" and NHNHB requests that the RTE project area be extended downstream to the next Impoundment area. Page 3-1 of the Wilder PAD (and the Bellows Falls and Vernon PADs) defines the RTE project area incorrectly. The correct definition should read "within a 1,000-foot buffer to the <u>project affected area</u>" which includes the riverine reaches. Section 3.1 of the 2012 RTE study report correctly states (and Figure 3.1-1 illustrates): "The study area (Figure 3.1.-1) includes the riverine environment within and immediately adjacent to the range of normal operational flows and impoundment elevations of the Projects. <u>This area extends from the upper limits of the Wilder impoundment in Newbury, Vermont and Haverhill, New Hampshire to Vernon dam at Vernon, Vermont and Hinsdale, New Hampshire.</u> Therefore, based on comments from NHNHB, the Rare, Threatened and Endangered Plant Species study conducted in 2012 and provided to NHNHB for review addresses the concerns of this study request. That report will be filed with FERC by April 30, 2013.

The Nature Conservancy

Date of Letter: 3/1/2013

Study Request No.	Project	TNC Study Request	Response
1	Wilder, Bellows Falls, Vernon	Evaluation of Project Effects on Impoundment Water Surface Elevations and River Flow Regime	Addressed in Study Plan Nos. 4 and 5
2	Wilder, Bellows Falls, Vernon	Instream Flow Habitat Assessment	Addressed in Study Plan No. 9
3	Wilder, Bellows Falls, Vernon	Impacts of Water Level Fluctuations on Floodplain, Wetland, Riparian, and Littoral Vegetation Communities and Habitats	Addressed in Study Plan No. 27
4	Wilder, Bellows Falls, Vernon	Determine fish assemblage structure in project-affected areas	Addressed in Study Plan No. 10
5	Wilder, Bellows Falls	Effects of the Wilder and Bellows Falls Projects on the Dwarf Wedgemussel (*Alasmidonta heterodon*)	Addressed in Study Plan No. 24
6	Wilder, Bellows Falls, Vernon	Project Effects on Populations of Tessellated Darter, *Etheostoma olmstedi*	Addressed in Study Plan No. 12

The Nolumbeka Project, Inc.

Date of Letter: 2/28/2013

Study Request No.	Project	Nolumb Study Request	Response
1	Wilder, Bellows Falls, Vernon	Comprehensive investigation and mapping of ancient traversing trail systems and fishing stations, etc.	The area to be studied by this request is not clearly defined (FERC study criteria 6), but appears to identify areas outside of TransCanada's three projects. Also, no nexus to the projects is provided (FERC study criteria 5). However, surveys requested by others at all three projects should address the requesters concern for conducting field studies within each project's APE. Reports containing confidential site information will have a limited distribution that will be determined by state agencies. See Study Plan No. 33
2	Wilder, Bellows Falls, Vernon	Comprehensive field survey of wildlife and botanical species/habitat	This request does not meet the criteria for a study request under §5.9(b). The requester does not define a geographic range or study methodology (FERC study criteria 6), and no nexus between project operations and effects on the requested study resource is identified (FERC study criteria 5). However, some aspects of this request are similar to valid study requests by others. See Study Plan Nos. 26, 27, 28, 29
3	N/A	Stabilization of the Wissatinneway property	This site is not in the area of the TransCanada Projects. Therefore it has no nexus to the project (FERC study criteria 5).

Study Request No.	Project	Nolumb Study Request	Response
4	N/A	Creation of a National Historical Park around the Great Falls fight site	This site is not in the area of the TransCanada Projects. Therefore it has no nexus to the project (FERC study criteria 5).
5	N/A	Falls Brook cleanup	This site is not in the area of the TransCanada Projects. Therefore it has no nexus to the project (FERC study criteria 5).

Town of Lyme, New Hampshire Office of the Selectboard, City of Lebanon, New Hampshire City Manager, and O. Ross McIntyre

Date of Letter: 2/26/2013

Study Request No.	Project	Lyme-Leb-McInt Study Request	Response
1	Wilder	Obtain data concerning piping erosion at the shoreline of the Wilder Dam impoundment and ascertain whether erosion may be reduced by changes in water level management practices	Addressed in Study Plan Nos. 2 and 3

Town of Rockingham, Vermont Conservation Commission

Date of Letters: 3/1/2013 (five submittals)

Study Request No.	Project	Rock Study Request	Response
4.2.1	Bellows Falls	Evaluate the projects operation and maintenance on Riverbank erosion (including the potential effects on protected species, cultural resources and structural integrity) of the Saxtons River Commissary Brook Estuary, Herrick's Cove and Upper Meadows areas	Addressed in Study Plan No. 3
4.2.2	Bellows Falls	Evaluate the Water Quantity and Quality of water entering the project area reservoir and impoundment area especially the Saxtons River, Commissary Brook Estuary and Williams River Estuary, Upper Meadows, Herricks Cove and CT River Reach around the BF Island formed by the canal.	Addressed in Study Plan No. 27, also see Study Plan No. 6
4.2.4	Bellows Falls	Terrestrial Resources: Williams River Estuary and Commissary Brook Estuary, Upper Meadows; – surveying TransCanada properties to document and locate where there are no buffers – (Upper Meadows) – federally endangered species – protection of the Northeastern Bulrush	Addressed in Study Plan Nos. 27 and 29

Study Request No.	Project	Rock Study Request	Response
4.2.6	Bellows Falls	Evaluate the adequacy of existing recreation and public use facilities in meeting existing and future regional public use and river access needs, the effect of project operations on quality and availability of flow-dependent and water level-dependent recreation opportunities	Addressed in Study Plan No. 30
4.2.8	Bellows Falls	Evaluate the adequacy of the aesthetics between the dam and the Hydro Power Plant area Canal	Addressed in Study Plan No. 32

Trout Unlimited, Deerfield River Chapter

Date of Letter: 3/1/2013

Study Request No.	Project	TU Study Request	Response
1	Bellows Falls, Vernon	Shad Population Model for the Connecticut River	TransCanada did not develop a study plan for this request. For a number of reasons, TransCanada does not believe this is a reasonable request. The effects of the Vernon and Bellows Falls projects on the whole of the population of American shad in the Connecticut River is proportionally small given the other impacts shad experience in the river (e.g., entrainment at Mt. Tom and Vermont Yankee, and three dams below Vernon). The numerous American shad studies TransCanada is proposing will identify project-specific effects on American shad. The cost to create a shad population model for the Connecticut River compared to the effects of the projects on the resource is excessive (FERC study criteria 7).
2	Bellows Falls, Vernon	Telemetry Study of Upstream and Downstream Migrating Adult American Shad to Assess Passage Routes, Effectiveness, Delays, and Survival	Addressed in Study Plan No. 21

Study Request No.	Project	TU Study Request	Response
3	Bellows Falls, Vernon	Impact of Project Operations on Shad Spawning, Spawning Habitat, and Egg Deposition in the Project Areas of the Turners Falls, Northfield Mountain Pumped Storage and Vernon Project Areas and downstream from Bellow Falls Dam	Addressed in Study Plan No. 21
4	Bellows Falls, Vernon	Evaluation of Timing of Downstream Migratory Movements of American Eels on the Mainstem Connecticut River	Addressed in Study Plan No. 20
5	Bellows Falls, Vernon, Wilder	American Eel Survey Upstream of the Vernon and Bellows Falls dams	Addressed in Study Plan No. 11
6	Wilder, Bellows Falls, Vernon	Downstream American Eel Passage Assessment at Vernon and Bellows Falls	Addressed in Study Plan No. 19
7	Wilder, Bellows Falls, Vernon	Model River Flows and Water Levels Upstream and Downstream from the Wilder, Bellows Falls, and Vernon Stations and Integration of Project Modeling with Downstream Project Operations	Addressed in Study Plan Nos. 4 and 5
8	Wilder, Bellows Falls, Vernon	Upstream American Eel Passage Assessment at Vernon and Bellows Falls Projects	Addressed in Study Plan No. 18
9	Vernon	Impact of Vernon Project Operations on Downstream Migration of Juvenile American Shad	Addressed in Study Plan No. 22

Trustees of Pine Park Association, Hanover New Hampshire

Date of Letter: 2/27/2013

Study Request No.	Project	HAN Study Request	Response
1	Wilder	Obtain data concerning piping erosion at the shoreline of the Wilder Dam impoundment and ascertain whether erosion may be reduced by changes in water level management practices by the dam operator	Addressed in Study Plan Nos. 1, 2, 3, 4, 5

Two Rivers-Ottauquechee Regional Commission

Date of Letter: 3/1/2013

Study Request No.	Project	Two-Riv Study Request	Response
1	Wilder	Comprehensive Recreation and River Access Study	Addressed in Study Plan No. 30
2	Wilder	Study on the Economic Activity Generated by Recreational Activity in the Project Area	TransCanada did not develop a study plan for this request. It was unclear in the request as to how the information obtained would be used in the development of new license conditions (FERC study criterion 5 and 6).
3	Wilder	River Bank Erosion Study	Addressed in Study Plan Nos. 2 and 3

Study Request No.	Project	Two-Riv Study Request	Response
4	Wilder	Comprehensive Decommissioning Study	TransCanada has not developed a study plan for this request. This issue will be addressed in the economic analysis and amortization requirement in each Project License. Existing information available to FERC is sufficient to address this issue. Consequently this request does not meet FERC study criteria 4.

U.S. Fish and Wildlife Service

Date of Letter: 3/1/2013

Study Request No.	Project	FWS Study Request	Response
1	Wilder, Bellows Falls, Vernon	Model River Flows and Water Levels Upstream and Downstream from the Wilder, Bellows Falls, and Vernon Stations and Integrate Project Modeling with downstream Project Operations	Addressed in Study Plan Nos. 4 and 5
2	Wilder, Bellows Falls, Vernon	Instream Flow Habitat Assessment Downstream of Wilder, Bellows Falls, and Vernon Dams	Addressed in Study Plan No. 9
3	Bellows Falls	Bellows Falls Bypass Flow (aquatic resources)	Addressed in Study Plan No. 9

Study Request No.	Project	FWS Study Request	Response
4	Bellows Falls, Vernon	Impacts of the Operations of the Turners Falls, Northfield Mountain Pumped Storage, Vernon and Bellows Falls Projects on Shad Spawning, Spawning Habitat, and Egg Deposition	Addressed in Study Plan No. 21
5	Bellows Falls, Vernon	Telemetry Study of Upstream and Downstream Migrating Adult American Shad to Assess Passage Routes, Effectiveness, Delays, and Survival	Addressed in Study Plan No. 21
6	Vernon	Impact of Vernon Project Operations on Downstream Migration of Juvenile American Shad	Addressed in Study Plan No. 22
7	Bellows Falls, Vernon	Shad Population Model for the Connecticut River	TransCanada did not develop a study plan for this request. For a number of reasons, TransCanada does not believe this is a reasonable request. The effects of the Vernon and Bellows Falls projects on the whole of the population of American shad in the Connecticut River is proportionally small given the other impacts shad experience in the river (e.g., entrainment at Mt. Tom and Vermont Yankee, and three dams below Vernon). The numerous American shad studies TransCanada is proposing will identify project-specific effects on American shad. The cost to create a shad population model for the Connecticut River compared to the effects of the projects on the resource is excessive (FERC study criteria 7).

Study Request No.	Project	FWS Study Request	Response
8	Wilder, Bellows Falls, Vernon	American Eel Survey Upstream of the Vernon, Bellows Falls, and Wilder Dams	Addressed in Study Plan No. 11
9	Wilder, Bellows Falls, Vernon	Upstream American Eel Passage Assessment at Vernon, Bellows Falls, and Wilder Projects	Addressed in Study Plan No. 18
10	Wilder, Bellows Falls, Vernon	Evaluation of Timing of Downstream Migratory Movements of American Eels on the Mainstem Connecticut River	Addressed in Study Plan No. 20
11	Wilder, Bellows Falls, Vernon	Downstream American Eel Passage Assessment at the Vernon, Bellows Falls, and Wilder Project	Addressed in Study Plan No. 19
12	Wilder, Bellows Falls, Vernon	Assessment of Adult Sea Lamprey Spawning within the Wilder, Bellows Falls, and Vernon Project Areas	Addressed in Study Plan No. 16
13	Wilder, Bellows Falls	Effects of the Wilder and Bellows Falls Projects on the Dwarf Wedgemussel	Addressed in Study Plan No. 24
14	Wilder, Bellows Falls, Vernon	Project Effects on Populations of Tessellated Darter	Addressed in Study Plan No. 12
15	Wilder, Bellows Falls, Vernon	Determine the Fish Assemblage in Vernon, Bellows Falls and Wilder Project-Affected Areas	Addressed in Study Plan No. 10
16	Wilder, Bellows Falls, Vernon	Determine Upstream Passage Needs for Riverine Fish Species in the Bellows Falls, Wilder and Vernon Fishways	Addressed in Study Plan No. 17

Study Request No.	Project	FWS Study Request	Response
17	Wilder, Bellows Falls, Vernon	Impacts of the Vernon, Bellows Falls, and Wilder Project Impoundment Level Fluctuations on Resident Fish Spawning	Addressed in Study Plan No. 14
18	Wilder, Bellows Falls, Vernon	Impacts of the Vernon, Bellows Falls and Wilder Project Operations on Tributary and Backwater Area Access and Habitats	Addressed in Study Plan No. 13
19	Wilder, Bellows Falls, Vernon	Impacts of Water Level Fluctuations on Aquatic Vegetation, Including Invasive Species, in the Vernon, Bellows Falls and Wilder Project Impoundments and Riverine Reaches	Addressed in Study Plan Nos. 27 and 29
20	Wilder, Bellows Falls, Vernon	Water Quality Modeling	Addressed in Study Plan No. 6
21	Wilder, Bellows Falls, Vernon	Climate Change as it Relates to Continued Operation of the Vernon, Bellows Falls, Wilder, Northfield Mountain Pumped Storage, and Turners Falls Projects	TransCanada does not propose to develop a specific study plan that addresses climate change as it relates to project operations. Such a study would not necessarily inform potential mitigation measures (FERC study criteria 4) and would be cost prohibitive (FERC study criteria 7). Potential operational measures that could be considered will be informed by the water level and project operations modeling (Study Plan 4 and 5, and water quality monitoring (Study plan 6).

Vermont Agency of Natural Resources

Date of Letter: 3/1/2013

Study Request No.	Project	VANR Study Request	Response
1	Wilder, Bellows Falls, Vernon	Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations (separate requests for each project, each request identified as request 1)	Addressed in Study Plan Nos. 2 and 3
2	Wilder, Bellows Falls, Vernon	Water quality monitoring within the project impoundment and tailrace (separate requests for each project, each request identified as request 2)	Addressed in Study Plan No. 6
3	Wilder, Bellows Falls, Vernon	Continuous water temperature monitoring at various locations within the impoundment and tailrace, and downstream Connecticut River (separate requests for each project, each request identified as request 3)	Addressed in Study Plan No. 6
4	Wilder, Bellows Falls, Vernon	Model river flows and water levels upstream and downstream from the Wilder, Bellows Falls and Vernon stations and integration of project modeling with downstream project operations	Addressed in Study Plan Nos. 4 and 5

Study Request No.	Project	VANR Study Request	Response
5	Wilder, Bellows Falls, Vernon	Climate change as it relates to continued operation of the Vernon, Bellows Falls and Wilder projects	TransCanada does not propose to develop a specific study plan that addresses climate change as it relates to project operations. Such a study would not necessarily inform potential mitigation measures (FERC study criteria 4) and would be cost prohibitive (FERC study criteria 7). Potential operational measures that could be considered will be informed by the water level and project operations modeling (Study Plan 4 and 5, and water quality monitoring (Study plan 6).
6	Bellows Falls	Bypass flow and habitat (aquatic resources)	Addressed in Study Plan No. 9
7	Wilder, Bellows Falls, Vernon	In-stream flow habitat assessment of downstream reaches	Addressed in Study Plan No. 9
8	Wilder, Bellows Falls, Vernon	Project effects on channel morphology and benthic habitat impacts	Addressed in Study Plan No. 8
9	Vernon	Juvenile shad outmigration	Addressed in Study Plan No. 22

Study Request No.	Project	VANR Study Request	Response
10	Vernon	Shad population model for the Connecticut River	TransCanada did not develop a study plan for this request. For a number of reasons, TransCanada does not believe this is a reasonable request. The effects of the Vernon and Bellows Falls projects on the whole of the population of American shad in the Connecticut River is proportionally small given the other impacts shad experience in the river (e.g., entrainment at Mt. Tom and Vermont Yankee, and three dams below Vernon). The numerous American shad studies TransCanada is proposing will identify project-specific effects on American shad. The cost to create a shad population model for the Connecticut River compared to the effects of the projects on the resource is excessive (FERC study criteria 7).
11	Bellows Falls, Vernon	Impact of project operations on shad spawning, spawning habitat and egg deposition	Addressed in Study Plan No. 21
12	Bellows Falls, Vernon	Telemetry study of upstream and downstream migrating adult American shad to assess passage routes, effectiveness, delays, and survival	Addressed in Study Plan No. 21
13	Wilder, Bellows Falls, Vernon	Fish assemblage in project-affected areas	Addressed in Study Plan No. 10

Study Request No.	Project	VANR Study Request	Response
14	Wilder, Bellows Falls, Vernon	Impacts of downstream water fluctuations on resident fish spawning	Addressed in Study Plan No. 15
15	Wilder, Bellows Falls, Vernon	Upstream American eel survey	Addressed in Study Plan No. 11
16	Wilder, Bellows Falls, Vernon	Project effects on populations of tessellated darter, *Etheostoma olmstedi*	Addressed in Study Plan No. 12
17	Wilder, Bellows Falls, Vernon	Assessment of adult sea lamprey (*Petromyzon marinus*) spawning within the project areas	Addressed in Study Plan No. 16
18	Wilder, Bellows Falls, Vernon	Impacts of impoundment water level fluctuations on resident fish spawning	Addressed in Study Plan No. 14
19	Wilder, Bellows Falls, Vernon	Impacts of project operations on tributary and backwater area access and habitats	Addressed in Study Plan No. 13
20	Wilder, Bellows Falls, Vernon	Evaluation of timing of downstream migratory movements of American eels on the mainstem Connecticut River	Addressed in Study Plan No. 20
21	Wilder, Bellows Falls, Vernon	Downstream American eel passage	Addressed in Study Plan No. 19
22	Wilder, Bellows Falls, Vernon	Upstream American eel passage assessment	Addressed in Study Plan No. 18

Study Request No.	Project	VANR Study Request	Response
23	Wilder, Bellows Falls, Vernon	Impingement and entrainment of resident fish species at project intakes	Addressed in Study Plan No. 23
24	Wilder, Bellows Falls, Vernon	Determine upstream passage needs for riverine fish species at project fishways	Addressed in Study Plan No. 17
25	Wilder, Bellows Falls, Vernon	Impact of impoundment water level fluctuations on wetlands (separate requests for each project, each request identified as request 25)	Addressed in Study Plan No. 27
26	Wilder, Bellows Falls, Vernon	Impacts of water level fluctuations on aquatic vegetation, including invasive species, in project impoundments	Addressed in Study Plan Nos. 27 and 29
27	Wilder, Bellows Falls	Project effects on the dwarf wedgemussel (*Alasmidonta heterodon*)	Addressed in Study Plan No. 24

Study Request No.	Project	VANR Study Request	Response
28	Wilder, Bellows Falls, Vernon	Assess the impact of project operations on state-listed rare, threatened and endangered plant species and significant natural communities	TransCanada did not develop a study plan for this request as we believe we have completed a study that addresses this request. Based on comments from the Vermont Agency of Natural Resources (VANR), the Rare, Threatened and Endangered (RTE) Plant Species study conducted in 2012 and provided to VANR for review addresses the concerns of this study request. That report will be filed with FERC by April 30, 2013. The intent of the VANR request for surveying the entire 100-year floodplain was, in our opinion, addressed in the 2012 study in that what species and communities were found were the ones that could be affected by Project operations. Further, in TransCanada's discussions with the resource agencies prior to the 2012 RTE study, the 100-year floodplain never came up in study consultation, and this request is not appropriate now since project affected areas were surveyed in 2012. We also surveyed species unlikely to be affected by project operations (category 2 species in the 2012 RTE study).
29	Wilder, Bellows Falls, Vernon	Survey the number, species and behavior of adult dragonflies and emerging nymphs within the project areas	Addressed in Study Plan No. 25
30	Wilder, Bellows Falls, Vernon	Survey for new and existing populations of adult Cobblestone and Puritan tiger beetle populations within the project areas	Addressed in Study Plan No. 26

Study Request No.	Project	VANR Study Request	Response
31	Wilder, Bellows Falls, Vernon	Survey the distribution, population size and habitat conditions of Fowler's Toad (*Bufo fowleri*) within the project areas	Addressed in Study Plan No. 28
32	Wilder, Bellows Falls, Vernon	Recreational survey and enhancement study	Addressed in Study Plan No. 30
33	Wilder, Bellows Falls, Vernon	Assess the amount of development within the floodplain of the lower Connecticut River	TransCanada did not develop a study plan for this request. The purpose of this request is to determine if river profile operations could be modified in locations to allow over-land flow in floodplains where waters would not cause damage or endanger public safety and community investments. Therefore, this is a mitigation request and there is no nexus to the projects as licensed, and the request does not meet FERC study criteria 5. Further, since this study request would not inform measures that could be considered for a new license it does not meet FERC study criteria 6. However, an assessment of current project effects on floodplain forests is included in Study Plan No. 27.
34	Bellows Falls	Bellows Falls aesthetic flow study	Addressed in Study Plan No. 32

Vermont Division for Historic Preservation, State Historic Preservation Office

Date of Letter: 3/1/2013

Study Request No.	Project	VT SHPO Study Request	Response
1	Wilder, Bellows Falls	Phase IB within archeologically sensitive areas and potential site locations that are actively eroding	Addressed in Study Plan No. 33
2	Wilder, Bellows Falls	Phase II of currently recorded archeological sites in the Project APE	Addressed in Study Plan No. 33
3	Wilder, Bellows Falls	Phase II of any other archeological site identified by Phase IB	Addressed in Study Plan No. 33
4	Wilder	National Register Evaluation Report	Addressed in Study Plan No. 33
5	Vernon	Phase IB within archeologically sensitive areas and potential site locations that are actively eroding based on 2013 Monitoring Report	Addressed in Study Plan No. 33
6	Vernon	Phase II of known archeological sites in the Project APE	Addressed in Study Plan No. 33

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TRANSCANADA HYDRO NORTHEAST INC.

Wilder Hydroelectric Project (FERC Project No. 1892-026)
Bellows Falls Hydroelectric Project (FERC Project No. 1855-045)
Vernon Hydroelectric Project (FERC Project No. 1904-073)

Revised Study Plan

Appendix C

Consultation Meeting Comments and Response Summary

Previously filed with the FERC on July 9, 2013

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TABLE OF CONTENTS

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1–3. EROSION STUDIES

A. Erosion Monitoring: Provide more detail, clarification on process, criteria and stakeholder consultation for determination and selection of erosion monitoring sites; including number of sites, where (distribution) and identification (locations on maps, GPS, landowner, etc.) in SP		
	Process can be described but the actual sites and details on why they were chosen will not be available in time for the revised study plan	Revised SP to describe process
B. Erosion Study: Provide more detail, clarification on process and approach (step-wise) to a possible more detailed analysis of erosion.		
	This pertains to sites we determine though our current proposed studies to be significantly affected by project operations.	Will consider pending evaluation but this is potentially beyond the scope of current studies.
C. Historic Documentation of Erosion: Make an effort to reach out to landowners for specific surveys associated with riverfront property that could lead to assessments of land losses due to erosion. Contact landowners.		
	Need to identify a cost-effective process and criteria for gathering valid (licensed survey) information (e.g., target landowners, send letters, review of archival information.	Added into SP only for sites with rapid erosion, significant changes etc. to manage cost-effectiveness.
D. Historic Documentation of Erosion: Contact NCRS offices for information associated with requests for assistance from riverfront landowners. (NH NRCS contact named by stakeholders was Steve Schmidt).		
	Revise Study Plan to incorporate consultation with NCRS offices.	Revised SP
E. Erosion Monitoring: Consider changes in proposed monitoring frequency due to observations of rapid erosion or based upon event triggers (high runoff events, ice scour, spring freshet). Identify and characterize events historically, frequency; if possible tie events to erosion observations or noted changes in morphology.		
	Describe plan for how to proceed with more details where rapid erosion is identified, need to identify added cost.	Revised SP to provide process for this and for consultation and change in monitoring frequency.
F. Historical Erosion/Erosion Monitoring/Erosion Study: How are we incorporating effects of Vernon discharge on erosion? Accounting for erosion below Vernon Dam. Delineate extent of Geographic scope on a map.		
	Based on study meetings, all applicable studies will include approximately 1.5 miles downstream of Vernon dam to lower extent of Stebbins Island	Revised SP to include 1.5 miles below Vernon dam
G. Historical Erosion/Erosion Monitoring/Erosion Study: Need provisions in SP for including locations and descriptions and develop attribute tables of all locations cited in the three studies. Map them in a manner in which information and locations can be shared.		
	Include language in each erosion SP describing such a GIS database	Revised SP

H. Historical Erosion/Erosion Monitoring/Erosion Study: Incorporate known or established standards or terms for erosion with respect to characterizations or descriptions, causal agents and study methodologies.		
	References for methods are included in the SPs, but not sure such "standards" exist. Need to do some research to see what can be incorporated into SP or as part of studies themselves.	Revised SP to describe evaluation as part of studies, rather than developing/incorporating standards in the SP.
I. Erosion Study: In describing methodologies and analyses – indicate how and the rationale for circumstances and locations in which 2D modeling will be used to evaluate project operation effects on erosion.		
	Expand language in SP section to incorporate this request	Revised SP At specific sites where cross channel variations exist, 2D would be helpful for additional details.
J. Historical Erosion/Erosion Monitoring/Erosion Study: Expand on our deliverables associated with each of the three studies. Expand and clarify the timetable for deliverables and consultation.		
	Some of this may have been in earlier drafts of SPs and can be reincorporated into plans	Revised in SPs
K. Erosion Study: Conduct a phased-approach which could lead to more precise evaluation of erosion; if project effects are considered significant within proposed study plan scope, what additional or options for additional studies are available and warranted. Describe the process for determining need for additional studies in the study plan. Describe additional study plan options or preferences or proposal in study plan rather than leave it ambiguous. Consider a more geotechnical approach (Mudge).		
	Examine options for higher level erosion studies following the proposed study; criteria for initiating this additional analysis: significant project effect determination.	Revised SP to describe process for sites displaying greatest rates of erosion, consultation with working group along the way to identify sites for additional study if warranted, and working toward process to evaluate in more detail.
L. Erosion Monitoring/Erosion Study: Consider long term monitoring in study plans or in the future. Should be consideration in a shoreline management plan.		
	Long term monitoring and a shoreline management plan are mitigation.	This is beyond the intent of this study, but there will be permanent monuments for future study if needed. Revised SP to indicate that the results of this baseline study will help to inform potential mitigation measures.

4. HYDRAULIC MODELING STUDY

<table>
<tr><td colspan="3">A. Provide more detail and clarification of calibration and verification methods, process and techniques in the study plan.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>Revised SP</td></tr>
<tr><td colspan="3">B. Provide more detail, clarification on process, criteria and stakeholder consultation for determination and selection of water level logger data that in part would be used for calibration and verification.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>Revised SP for process and criteria for calibration, and relative to consultation for verification.</td></tr>
<tr><td colspan="3">C. Provide more detail on accuracy of data logging equipment, LiDAR, bathymetry sounding equipment. Provide more description on QA/QC methods and control.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>Revised SP for LiDAR.

Data loggers and bathymetry equipment revisions are in SP No.7</td></tr>
<tr><td colspan="3">D. Provide more detail, clarification on association with other studies and goals: 1.) Data input into the hydraulic model from data collected and described in all the associated studies; 2.) Relations ships of how and methods for using the information from hydraulic model to the various resource studies to describe project effects</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>Revised SP and includes a flow chart illustrating relationships – draft version included on next page here.</td></tr>
<tr><td colspan="3">E. Explain use of “Mannings N” value and how it would be used or adjusted for calibration.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>Revised SP</td></tr>
<tr><td colspan="3">F. Time step clarification sought: data logging time step, model time step</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>Revised SP for data-logging 15-minute time step and model time step of 1 hour, with sub-hourly time steps (in study No. 5)</td></tr>
<tr><td colspan="3">G. Provide more detail, clarity, method associated with dynamic routing. Where might this be used? Particularly at the upstream extent of the impoundment where effects are associated with impoundment fluctuations and inflow or upstream project discharge.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>Revised SP</td></tr>
<tr><td colspan="3">H. Examine capabilities and opportunities to use sub-hourly time steps to evaluate more precision in certain operational conditions (likely this refers to discharge-rates of change in elevation-rate of ramp)</td></tr>
<tr><td></td><td>Consult with TC Operations on unit loading/unloading procedures and identify need for sub-hourly time steps with resource studies.</td><td>Revised SP to include sub-hourly time steps on a pilot basis to evaluate the need for this in the larger study context.</td></tr>
</table>

5. OPERATIONS MODEL STUDY

A. Provide more detail and clarification on the selection criteria for the specific 5 years of hydrology: 1992, 1994, 1989, 2007 and 1990 proposed. How they represent range of conditions both annually and seasonally. Clarify the hydrologic assessment that relies on 5 years; why not 40 years; provide better understanding.		
	Revise Study Plan	Revised SP for selection criteria and clarification.
B. Provide more detail and clarification on the 1.) use and purpose as well as 2.) the selection criteria associated with 2010 energy prices as pricing signals in the model. Describe the energy data set. Describe the development, validity and of the pricing data and how it reasonable to use in the model.		
	Revise Study Plan	Revised SP to include more detail and clarification.
C. Add additional definition of costs associated with model development and alternative runs; adding new structures or nodes.		
	Revise Study Plan	Revised SP to include subtasks and costs.
D. Specify routing functionality or details used in the operations model.		
	Revise Study Plan	Revised SP to provide more information.
H. (from Study 4 above) – Examine capabilities and opportunities to use sub-hourly time steps to evaluate more precision in certain operational conditions (likely this refers to discharge-rates of change in elevation-rate of ramp)		
	Consult with TC Operations on unit loading/unloading procedures and identify need for sub-hourly time steps with resource studies.	Note that this sub-hourly modeling approach process has been finalized and plan will be updated in this plan and perhaps in other plans as well. We are not proposing to do this under the normal operations modeling process, and for use in all cases. It is extremely intensive, and will only be used only in instances when it is clear that a particular resource is impacted on an hourly basis. If the models show a significant impact, we will attempt to employ this technique. This will be based upon the other habitat studies associated with flow velocity or depth has been shown to be significantly affected by project operation.

6. WATER QUALITY MONITORING STUDY

A. Revise study plan to include tables similar to 2.1-1 and 2.2-1 of the 2012 Baseline WQ report. Table 2.1-1 includes a description and Lat/Long for each WQ station ("approximately" or "near").Table 2.2-1 is a summary of the type and frequency of sampling that will occur at each station. We also said we'd include a map showing approximate station locations.		
	Revise Study Plan	Revised SP and tables added. This study is intended primarily as an extension of the 2012 study for consistency, with some additional monitoring.
B. Include description of measures and tactics for QA/QC in Study Plan		
	Revise Study Plan	Revised SP based on 2012 study.
C. Include provision in the SP for uploading WQ data to the NH Environmental Monitoring Database		
	Revise Study Plan	Revised SP
D. Include provision for downloading reservoir data on the same or near approximate same date for each reservoir to the extent reasonably possible.		
	Revise Study Plan	Revised SP. We will attempt to do this to the extent possible, given the length of the impoundments and time needed to download each monitor.
E. Add or ensure WQ monitoring occurs in Bypass Flow Demonstrations for Aquatic Habitat		
	Revise WQ and Instream Flow Study No.9	This applies study No. 9 - instream flow) and is included therein. There will be several demonstration flows planned and WQ data collected. This data will be included in the WQ study.
F. Suggest season for Temperature logging to extend from April 1 thru November 15 – primarily for fish habitat concerns		
	This can be accomplished by relying on the continuously recording temperature units at all three fish ladders from early spring (after ice-out) to late fall (prior to significant freezing) as part of study 17 – Upstream Passage of Riverine Fish Species. Temperature data for 2013 will also be available from the data loggers installed as part of Study 7 – Aquatic Habitat Mapping, and additional water temperature monitoring would occur from early April through much of the summer as part of the resident fish spawning in riverine reaches and impoundments (studies, 14 and 15).	Revised SP based on this proposal. It may also be possible to obtain VY's temperature data submitted to VANR on a monthly basis as part of VY's NPDES permit. TC to contact VY and State of VT about ability to obtain data submitted to the state.

G. Collect Temperature data above VY and below to discern temperature plume		
	We propose to add water temperature monitoring at vertical and horizontal transects upstream and downstream of VY from October 1 through November 15.	Revised SP.

7. AQUATIC HABITAT MAPPING STUDY

A. Note in the SP as to the ability or desire to perform the bathymetry mapping at the highest pond possible.		
	Consult with TC Operations and determine the extent possible for summer 2013.	Revised SP. We will attempt to do this based on flow/elevation changes and timing, and rain events.
B. Provide clarity and criteria for adjusting and collecting 1-foot contour bathymetry when depths are 10 feet or less from top of reservoir max elevation, regardless of whether along edge or in center of river (i.e., islands).		
	We understand the request; however adding 1 foot contour generation is a significant increase in cost and effort and we will consider alternatives to address this request in a reasonable manner. Comment: there are no data loggers for significant distances. From Wilder to Blood Brook. Noted, may add another logger in this area. This is a first cut. Email John R with additional ideas for placement.	Changes in SP have not been determined at this point. Noted, may add another logger in this area, and there are several extra data loggers that can be deployed. Email John R with additional ideas for placement of data loggers.
C. Provide greater clarity on substrate sampling methods, techniques; particularly in the deeper areas associated with downstream (riverine) reaches. (drag chain, copper pole methods suggested)		
	Revise SP	Revised SP
D. Note in the SP as to the ability or desire to perform the bathymetry below the dams (in riverine section) during low flow conditions, for the purpose of mapping the transition area from riverine to impoundment.		
	Consult with TC Operations and determine the extent possible for summer 2013.	Revised SP Statement added to address this in the first paragraph of the methods. Note that bathymetry is not the appropriate technique for riverine sections. See response to G below.
E. Provide more detail on accuracy of instruments, bathymetry sounding equipment. Provide more description on QA/QC methods and control.		
	Revise SP	Revised SP Added detail to QC habitat methods Added bathymetry QC detail to methods section along with reference to NOAA survey guidelines being followed

F. Consider methods to assure coverage of so-called transitional zones (areas impacted by impoundments and discharge – sometimes exclusively and other time concurrently). Expressed desire to map under impoundment conditions (high pond) and map as riverine (low flows).		
	Consult with TC Operations and determine the extent possible for summer 2013.	Revised SP as noted above
G. Deeper areas in the riverine habitats below the dams may require additional methods to acquire bathymetry. Please identify methods that will be considered as well as those that cannot be used and explain merits or issues associated with each. Identify criteria or decision making (when and why) that will drive the decision to use a particular method.		
	Identify options – may not be practical to do.	SP clarified Bathymetry was limited to the impoundment sections as the equipment to conduct that work needs to be mounted on an appropriate survey vessel and should not be bouncing around in riverine sections with limited access and/or shallow water obstacles. Mesohabitat mapping will be conducted as part of the instream flow study (No.9) and this work will occur in the riverine sections.

8. CHANNEL MORPHOLOGY AND BENTHIC HABITATS STUDY

A. Explain the selection process for tributaries and assessment locations in the SP.		
	Revise Study Plan	Revised SP to clarify that the process will include stakeholder involvement.
B. Suggestion that we include: Cold, Saxton's River, Williams, Mascoma and White		
	Revise Study Plan	Revised SP
C. We should include a quantification of embeddedness of the gravel with particular attention to habitat suitability.		
	Revise Study Plan	Revised SP - EPA rapid bioassessment protocol will be used and study plan revised to reflect this.
D. Provide more detail, clarification on process, criteria and stakeholder consultation for determination and selection of tributaries		
	Revise Study Plan	Revised SP

9. INSTREAM FLOW STUDY

A. Include (study) "riverine" reach below Vernon in the riverine instream flow study.		
	Based on study meetings, all applicable studies will include approximately 1.5 miles downstream of Vernon dam to lower extent of Stebbins Island	Revised SP
B. Habitat versus Persistence must be accounted for in the study [plan].		
	Revise Study Plan	Revised SP
C. Analysis of time series impacts and fluctuating flows analysis should be done for more than just benthic habitat – should include riverine reaches. Clarify in the SP as this is our intent using HSI's and operations model.		
	Revise Study Plan	Revised SP
D. Include suite of immobile, immature life stages in the study. Mentioned were: macro invertebrates; eggs; small fish; sea lamprey; long-nose dace;		
	Revise Study Plan	Revised SP to include Tesselated darter and Dwarf wedgemussel
E. Include Tessellated Darter to the species list. Associate this study with Study 12 specific to this fish.		
	Revise Study Plan	Revised SP
F. Clarify process and consultation which will be used to determine Instream Flow Study Transects. Proposed transects need not be included in SP, only the process associated with final determination.		
	Develop consultation process – proposing transects, agency consultation, field visitations and final determination. Include timetable for conducting this. How this will be done based upon habitat mapping results?	Revised SP
G. Dual –flow analysis - if it was inherently proposed, provide greater clarity as to that being the intent. If it was not proposed, consider. Indicate or describe proposed flow levels if appropriate.		
	Review approach and revise Study Plan if appropriate.	Revised SP This is related to immobile life stages requested. This is the most effective way to do it, and it has been used before on other instream flow studies.
H. Indicate whether or not a HSI criteria meeting is being proposed in the Consultation and Selection process. If so indicate when this would take place along with a general timetable for all steps in the process outline above.		
	Revise Study Plan	Revised SP
I. Clarify process and consultation which will be used to determine Habitat Suitability Indices (HSI). Proposed HSIs need not be included in SP, only the process associated with final selection.		
	Develop consultation process – developing HSIs, proposing them, agency consultation, meeting and final determination. Include timetable for conducting this.	Revised SP - HSI likely to be those used for TF project and will be selected this winter in consultation with the working group.
J. Overall Schedule and timing and processes in determination of HSI curves and transects could be more clearly defined and presented in the SP.		
	Revise Study Plan	Revised SP

10. FISH ASSEMBLAGE STUDY

A. Suggest standard sampling methodology (VANR gave reference to refer to) for future comparison, randomized/replicate sampling at each location. Goal to improve ability to draw inference and reduce sampling error.		
	Will review the reference. We use EPA standardized method. We will look for any updates in that protocol also.	Revised SP for methodology. Stratified random sampling design now being considered.
B. Consider randomized/replicate sampling at each location. It is better to have data to draw inference on. Reduces sampling error. [K Kennedy]		
	Will consider	Revised SP to reflect this approach – see response to comment A
C. Beneficial to have analysis incorporate size category, and a measure of variance in that. Requests coefficient of variation to compare across different gear types. CV < 20 are desirable.		
	Revise Study Plan	Revised SP.
D. Include turbidity in WQ data collection and specify time of day for electrofishing (or include time of day as a covariant)		
	Revise Study Plan	Revised SP.
E. Specify the time of day or night for each sample and be sure to include it as a co-variant in the analysis.		
	Revise Study Plan	Revised SP. see response to comment D
F. Include turbidity in the WQ sampling at each sample location		
	Revise Study Plan	Revised SP. see response to comment D
G. 2 hour gill sets at night are preferable to the proposed 24 hour sets – to reduce "fish gilling" mortality or injury. FL using trapnet for deeper water. Trawl for deeper waters similar to darter sampling we propose.		
	Revise Study Plan	Revised SP to rely on 2 hour gill net sets. These will be done at night to increase likelihood of catch. 2 hour sets will reduce mortality and satisfy the VT fisheries request to do so. Study No. 10 will rely primarily on boat electrofish with supplemental gill/trap netting. We are not proposing additional trawl sampling but will incorporate results from Study No. 12 (darter trawling).
H. Review study requests for methods (gear), temporal variation (day or night) etc.		
	Revise Study Plan	Revised SP to clarify in methods section to explain gear use including conditions that must be met to use a particular type of gear and what time of day that gear would be used.
I. Specify electrofishing locations particularly with respect to setbacks and side		
	Revise Study Plan; Clarify and provide detail as needed	Revised SP methods section to provide more detail on fish sampling in setbacks vs. mainstem areas.

J. Eagles –if using trapnets, consult w/ FWS on gear types and impacts on eagles. Get a permit for activities. Would gill netting also be a concern? Probably not if at night.		
	If use of trap nets are specified, address this and revise Study Plan	Revised SP.
K. Think through on study design to be sure it meets variety of goals, methodology, data collection, temporal etc., gear types to develop sampling design.		
	Revise Study Plan	Revised SP. See comment A. Following discussion with Katie Kennedy and review of FL plan and associated references have modified our approach.
L. Is there sampling in the setbacks or just mainstem? If so, specify method. Fyke nets may be appropriate method in those locations. Clarify in plan		
	Clarify sampling in setbacks and shallows; specify method in plan. Consider sampling in locations even if not fluctuating enough to impact spawning (in that study).	Revised SP. Setbacks that occur within one of our randomly selected segments will be sampled to the point that equipment can operate and area is still within the influence of project operations.
M. Capture assemblage below Vernon Dam		
	Revise plan to sample below Vernon to a location just below Stebbins Island. Utilize any VY data available	Revised SP. Added an additional stratum (Vernon to downstream end of Stebbins Island (1.5 miles)). Will be sampled following same methodology used in other locations. Will need to review publically available VY data as part of study.
N. Commit to a repetitive study year or season if conditions are abnormal? [K Kennedy] – one way around those drawbacks (e.g. drought) is to sample outside of the project to reflect "natural" conditions and not on the project.		
	We will rely on ILP regulations for anomaly conditions requiring additional year, as applicable to all studies.	No changes in SP, consultation will be ongoing for all studies. Progress reports and study reports will be prepared and shared for comment.
O. Need scientific collecting permit from VT F&W for fishing in VT water. Also in NH		
	Specify in SP that we will secure all necessary permits for study	Revised SP. Sentence added to plan in Schedule section

11. AMERICAN EEL SURVEY

A. Study Plan should specify bait material, options for such.		
	Revise Study Plan	Revised SP.
B. DS passage prescriptions should not be based on this result; a watershed survey should be done to provide data for passage prescription.		
	We disagree; any requirements for DS passage should be based upon evidence of eel in the project requiring passage due to the degree of unknowns in terms of life stage behavior and variability.	Revised SP to clarify TC position and study scope limited to mainstem.
C. Consider MacKenzie sampling approach to potentially acquire more definitive results. Consider improving sample design. See "robust" comment below.		
	1. Identify what this is (inquire with K. Kennedy); 2. Revise Study Plan if needed	Revised SP for random selection of transects, but not including MacKenzie method. Discussed with Katie Kennedy. Similar approach to Study No. 10. Five different strata.
D. Expand surveys into the tributaries and associated water bodies; at least to the base of the tributary barriers.		
	We disagree; any requirements for assessing project operations on the eel population should be based upon evidence of eels in the project either in terms of presence in the project or requiring passage. This strikes TC as a study to develop management goals and objectives and provide more information on the population rather than project effects. Consider locating surveys at the tributaries of noted interest but within the portions affected by project operations. Revise Study Plan as necessary	Revised SP to include tributaries within the influence of projects that are within the random transects.
E. Design plan to accommodate a robust sample within the project affected areas including repeated samples or visits over the time period associated with the study.		
	1. Consider how this might work and the criteria for making a determination of where and how many visits or repeated samples. 2. Revise Study Plan as necessary.	Revised SP. see comment C above
F. Setting up the Hydro acoustics array at Vernon would support this study.		
	Noted. HA option addressed in Shad Migration Study No.22	No change in SP – for a variety of reasons (in study No. 22), hydroacoustics is not appropriate at Vernon. The study objective is to look at run-timing, not population.

G. Comment on tagging, loosely associated with Study No. 19 (Downstream eel passage). Is TC tagging yellow eels, or willing to? TC monitor in impoundments and VT would take over when eels entered VT tribs.		
	Will we be monitoring movement in project waters using fixed and mobile tracking? Revise plan to clarify above and that we can provide tag information to agencies.	No changes in this SP (No.11). We are not proposing to tag/track eels in this study, which is in situ sampling of abundance and distribution only. See study No. 19 section.

12. TESSELLATED DARTER SURVEY

A. Consider (Hertzog et al) trawling in reverse from stern How not to lose sample, capsize boat, etc		
	Will look at that method, as conditions apply. Habitat mapping this summer will allow getting together in the fall with agencies based on habitats found to identify sites. Will utilize "bevy" of techniques as appropriate.	No changes made in SP, field staff have extensive experience under a range of conditions and are aware of the hazards of trawling.
B. All sampling design comments from Study No.10 Assemblage study (randomization, temporal, etc) apply to this study.		
	Consider this in a possible study design revision.	Revised SP for sampling strata as in studies No. 10 and 11. Still will sample at known Dwarf wedgemussel sites.
C. 2nd paragraph mis-interpreted the agency request (e.g. definition of effects), since study design as is, adequately covers the requests.		
	Will delete if this makes sense or is not critical	Revised SP - deleted.
D. Include turbidity measurements in the WQ sampling at sampling locations.		
	Revise Study Plan; Clarify and provide detail as needed	Revised SP - added

13. TRIBUTARY AND BACKWATER FISH ACCESS AND HABITATS STUDY

A. Clarify the timing of the initial survey /field assessment of all setbacks and tributaries as being Early August – September (2013???), with follow-up survey in 2014 of the selected subset.		
	Revise Study Plan	Revised SP.
B. Clarify criteria for selecting tributaries and setbacks, describe anticipated consultation process with working group.		
	Revise Study Plan	Revised SP.
C. Discuss depth at mouth of tributary or setback that would trigger concerns relative to fish movement (i.e., depth barrier).		
	Revise Study Plan	Revised SP. 1 foot or less at low water, based on the 2013 aquatic habitat mapping study No. 7 results using pressure transducers so that the range of operations is defined.

14. RESIDENT FISH SPAWNING IN IMPOUNDMENTS STUDY

No comments on SP		
		Revised SP. A few minor edits to methods section to make sure a few points were standardized between this SP (14) and SP15

15. RESIDENT FISH SPAWNING IN RIVERINE SECTIONS STUDY

A. Add detail on egg trap placement and sampling protocol; SP needs further definition. [is there a need for consultation with stakeholders?]		
	Revise Study Plan	Revised SP methods section edited to add more detail on egg trap construction and the criteria we will initially use to identify potential sampling spots.
B. Include (study) "riverine" reach below Vernon in the resident fish spawning in riverine study.		
	Based on study meetings, all applicable studies will include approximately 1.5 miles downstream of Vernon dam to lower extent of Stebbins Island	Revised SP to include downstream of Vernon approximately 1.5 miles
C. Longnose Dace should be added to the list of species, if identified in part through the fish assemblage study.		
	Revise Study Plan	Revised SP - added
D. Salmonids should also be included; noting if and where spawning occurs.		
	Revise Study Plan	Revised SP - added

16. SEA LAMPREY SPAWNING ASSESSMENT

A. Rick's comment in describing plan, that this is not in the plan		
	Revise plan to state putting out pressure transducers if we find spawning areas	Revised SP.
B. Clarify that non-telemetered areas (based on physical habitat) and we find redds will be monitored.		
	Revise plan to include what we do when we go to these habitat sites and find redds. Do we then treat them the say way as others? Also clarify the number or "up to how many additional" physically identified redds we will also monitor. See comment D below	YES. Also other spawning studies we will focus on shallow areas and will look at them. Revised SP to clarify that we will monitor as many as we can within reason/limitations.
C. Use of habitat data – if half go to tributaries and/or scatter, that doesn't lead you to more than that fish.		
	May have to find some by plane if needed and they go up tributaries.	Revised SP.
D. Need to identify how many redds you'd measure – specify level of effort to represent adequate sampling and habitat variability. Analysis is subjective so need a lot of redds to get adequate information		
	Clarify in plan - we will count all redds and then subsample.	Revised SP.
E. Tagging should be representative of migration timing – cover the entire season. USGS has been pit-tagging at Holyoke and receivers at TF and Vernon, may provide some info to help inform rates/timing.		
	We won't take the first 20. The goal is to try and select tagged fish throughout the migration period. Clarify and revise plan.	Revised SP. Clarified to spread fish tagged out over different periods
F. What is the scale of the effects analysis? Per redds? Per colony per habitat unit.		
	Will be based on what we find – but will be broad representation of what we find. Specify scale of effects analysis in the plan.	We will try to do per colony/grouping within each habitat, will report everything found. Will locate and record depth of all. Could also randomly select which ones are capped. Revised SP to clarify.
G. Let agencies know if fish move out of the area, so they can be tracked in the states.		
	Will do, add this into plan – will provide/share codes of our tags with states.	Revised SP.

H. [Lael] Refer to Gallagher – standard methods for changes in habitat over period they are actively spawning. Record % embeddedness when evaluating substrate etc. sedimentation within redds (impact on the resource).		
	Specify in plan – once we find redds, additional field work every day in daylight with photos, also will have turbidity data. Also add embeddedness. (see 4th paragraph on p.113 of PSP) in the event of no telemetered fish leading us to that spot, will still look in suitable habitats.	Revised SP. Clarified, but not sure of the Gallagher reference, need a citation in order to review that.
I. Operations data collected at redds? Capture various operational conditions		
	Clarify and add detail on operations data collected and how at redds – may locate pressure transducers; measure velocity and depth at time of observation and link to discharge/elevation at station or other means of estimation of flow. Coordinate with TC Operations to understand what is going on operationally while in daily surveys of redds. Indicate how we will attempt to observe redds under varying flow conditions	Revised SP with clarifications.

17. UPSTREAM PASSAGE OF RIVERINE FISH SPECIES ASSESSMENT

A. Fish Ladder Operational monitoring: ***a. Will you record the number of times etc that the fishways get blocked? Check often enough to ensure that ladders operate correctly for the study.*** ***b. [J Warner] – maybe get FWS engineers, station staff, study staff together to identify the visual effects of things blocking the fishways.*** ***c. Or periodically shut down to check ladders.***		
	We don't want to shut the fishways unless they really get blocked. TC will work with station staff to set up an inspection schedule/protocol. Perhaps seasonal shutdown – after spring run and after fall run. Revise plan as needed	Revised SP. Sampling will occur during the open water period (ice-out until freezing temperatures make it infeasible). TC will develop an in-house protocol for station personnel to assess ladders for blockages on a weekly basis. If a significant blockage is suspected, TC can shut down and address either after the spring or summer periods.

B. Use of VT's Salmonsoft licenses; Receive training and orientation from VT; set-up at Wilder		
	Clarify and confirm in Study Plan: • Confirm use of Salmonsoft licenses held by VT. • Determine hardware or additional software needs. High processing speeds for software. • Develop set –up system for Wilder	Revised SP. Added use of VT licenses to SP, added cost to purchase of 3 laptops that can handle the salmon soft software transferred from VT (minimum of a dual core computer running at 2.0 ghz with a suitable video capture device, a minimum of 2 GB of RAM, running Windows XP (preferred) or Windows Vista. The recommended video board is the Plextor PX-AV200U)
C. High turbidity events that preclude seeing fish via Salmon Soft - and record those events. Turbidity doesn't allow Salmon soft to capture the frame if there is movement in the ladder. Sun can trigger salmonsoft and small light directly into window for nighttime is useful too.		
	Specify in plan – 24 hour Salmonsoft usage. Consider the experience from Vernon to ensure the best data collection. Could use the 2nd camera side-by-side. FL will share their experience downstream to help study design. VANR can provide protocol.	Revised SP. Added text to specify 24 hour coverage. Added text saying we would operate 2nd non salmonsoft camera during turbid periods after rain events. Added text saying TC can confer with VT and FL to install proven design improvements for limiting sun and night time interference.
D. Salmonsoft was designed for upstream. If one fish goes upstream and on that goes downstream at the same time, Salmonsoft can cancel out each other.		
	There are work-arounds in the software. Identify methods to address this and enable both up and down counts. Clarify and specify procedure in revise SP accordingly	Revised SP. Added text saying TC would confer with FL and VT to learn about getting net counts from Salmonsoft
E. 1-year study may limit identification of early and late season species use (walleyes for example). How early will you open the ladders? If see fish moving early and late, it might be important to define those time frames. [K Kennedy] – can record temp, flow, elevation etc at the time of first and last seeing fish. Then license conditions could be based on date and/or those conditions		
	We expect to be able to get ladders open as soon as reasonably possible and run as late as reasonably possible or when it appears as if no use is observed. Will need to develop a monitoring protocol in real time rather than wait until season is over to observe and process salmon soft information. Clarify this and revise the SP	Revised SP. Clarified in SP: Ladders will open as soon as logistically possible (i.e.no ice). We will record operational parameters. Monitoring of video files/analysis of data etc. will occur throughout the study, not at the end of the study.

F. Page 122, schedule says April date.		
	Correct this in the SP. NOTE – will need to coordinate with CRASC and FWS on fishway inspections early at all projects, not just Vernon. Will periodically check in with agencies on status, especially if there are issues that arise. Revise Study Plan	Revised SP. Revised SP to reflect the open water period (ice-out until freezing temperatures make it infeasible) Sentence added to indicate TC will coordinate fishway inspections with agencies to ensure timely start to monitoring.
G. Will Salmon Soft software run 24 hours continuously?		
	Clarify if this is what we are aiming for in SP. If there is some unforeseen reason why this becomes a problem, we will immediately notify agencies and stakeholders.	Revised SP. Clarified 24-hour monitoring. Added a few sentences at end of methods saying TC will be in contact with agencies and if our proposed methodology is not working well, will seek alternate approaches in consultation.
H. Consider setting up trial at Wilder in 2013		
	We will consider this as an option based on VT work in 2013, but no revision expected in Study Plan	No change in plan.
I. Consider using 2013 recording data for training on species Identification.		
	We will consider this and indicate in Study Plan if needed.	Revised SP. added

18. AMERICAN EEL UPSTREAM PASSAGE ASSESSMENT

A. Revise Study Plan schedule: monitor with night surveys and eel traps in the first year to identify potential locations for temporary upstream passage devices, install and test those sites in the second year. Include an element of stakeholder consultation prior to passage device deployment.		
	Revise Study Plan	Revised SP to reflect a two year approach Year 1 – systematic surveys – visual searches and eel pots Year 2 – following consultation with agencies after year 1, temporary eel passes will be installed at appropriate locations where suitable eel concentrations were detected.
B. Comment that the minimum number of pots should be 10.		
	1. Unclear as to how many we are proposing. Is this per project? Up and downstream? Is this a critical item? Discuss with TC prior to revising SP 2. Clarify number to potentially address this concern. 3. Revise Study plan as necessary	Revised SP. We are proposing to fish at least 10 pots per project. Clarified SP to indicate that this is 10 pots at each Project and they are placed in areas DS of the dam
C. Study design should account for and document re-captures though some sort of marking of eels prior to releasing them.		
	Revise Study plan as necessary	Revised SP. Rather than marking yellow eels (some of which have the potential to be very small and difficult to mark), SP has been edited to have eels captured in eel pots during year 1 passed over dam – similar to approach for temporary eel traps during year 2. This will alleviate agency concerns over recaptures impacting estimates of eel congregations below projects
D. Study Plan should include consideration for a smaller mesh size associated with traps and specify such.		
	Revise Study plan as necessary	Revised SP. Reviewed available literature pertinent to mesh retention of eels and agree with agencies. Have modified SP to propose the use of 1/8 " mesh which will greatly increase retention of smaller eels

19. AMERICAN EEL DOWNSTREAM PASSAGE ASSESSMENT

A. In SP, discuss pros and cons of PIT and radio telemetry for this site and this study, provide rational for choosing not to include PIT.		
	Revise Study Plan to explain the rationale and experience for choosing radio telemetry and not PIT technology.	Revised SP to describe rationale.
B. Consider survival studies through spill gates in the scope of the study.		
	1. What are the gate passage options for eels specific to projects including gate operation priority and flow in terms of how they operate – bottom or surface; minimum flow or gate opening etc. 2. Is there literature on adult eel gate passage survival? 3. Consider an assessment methodology that would reach a consensus as to whether or not additional survival studies would be necessary in a second study season.	SP clarified as follows: TC expects gate passage survival to be high in general. As part of the route selection study, we will consult with TC Operations on gate structures operations to evaluate potential gate-specific issues. We are not aware of literature on gate passage, but can review as part of the study. We could consider gate survival evaluation if the route selection portion of the study indicates that a significant proportion of fish use the spillways and if sufficient numbers of fish are available (see C below). We will consult with the aquatics working group on the need for potential changes to the scope of the survival portion of the study and/or an alternate desktop methodology to assess this.
C. Sample size per turbine types appears low – consider boosting sample size per unit type		
	1. Evaluate the additional scope and cost. 2. Revise Study Plan as necessary and provide rationale.	SP clarified as follows: The survival sample size in the study plan is the same as requested by the resource agencies (including survival through all passage routes). It appears that agencies realize that a large number of eels would likely not be available, so they specified 50 for each project. By limiting survival to just turbines and not gates, the number of fish per turbine type is increased. We also believe that the number of tags and effort required to capture higher numbers of fish (if available) for survival studies would be cost-prohibitive. We propose to use the preliminary route selection data to focus allocations of fish for turbine survival (and gate survival if

		appropriate - see B above). For example if 60% of the fish in the route selection study use turbines 1-4 (a single turbine type) at Vernon then 60% of the allocated 50 eels for that site would be tested through one of those turbines
D. To what extent will the study incorporate the results of the radio-tag (RT) monitoring results (route selection, movement activity, preferences, or lack thereof) and the survival analysis portion of this study? Will or should the RT results determine the scope or distribution of survival study distribution?		
	Revise Study Plan as necessary and provide clarity on the process or linkage.	Revised SP to clarify – see also comments B and C above.
E. Study plan should reflect radio tagging releases to coincide with the mid-September thru early October period.		
	Revise Study plan as necessary.	Revised SP. Field study will be conducted late August through mid-October.
G. [from Study 11 discussion] Comment on tagging, loosely associated with Study 19 (Downstream eel passage). Is TC tagging yellow eels, or willing to? TC monitor in impoundments and VT would take over when eels entered VT tributaries?		
	Will we be monitoring movement in project waters using fixed and mobile tracking? Revise plan to clarify above and that we can provide tag information to agencies.	Revised SP for clarity. This study and requests were for silver eels only. We are not proposing to tag yellow eels. Manual monitoring is already included in the plan along with fixed stations. Revised SP to share tag information with agencies in addition to sharing with FL.

20. AMERICAN EEL DOWNSTREAM MIGRATION TIMING ASSESSMENT

A. Include potential American eel observations noted during Study 17 in the information and assessments presented within Study 20		
	Revise Study Plan to reflect that observations and timing from Study No. 17 will be documented in Study 20	Revised SP. Included that observations from study 18 – upstream eel passage, study 17 – resident species upstream passage (may have incidental eels) and study 11 – eel survey will be used to supplement and inform this study
B. Consider extending scope of the study into the tributaries of the CT River.		
	TC does not intend to expand the geographic scope of this study to include an assessment of American eel in tributary waters. TC considers this expansion to be a request to perform species management analyses rather than a study to determine the effect of project operations on American eel migration timing.	No change in the plan. This is a desktop study only, no field work is involved.
C. Revise the study plan objectives and goals when stating that because so few eels were captured above the dam, state "in the mainstem" because there may be many eels in tributaries and lakes.		
Clarify this in the study plan		Revised SP.

21. AMERICAN SHAD TELEMETRY STUDY - VERNON

A. In SP identify what the goal and differences this study contains versus the Study in 2012 conducted by USGS with TC support. Identify why we believe the 2012 data that has not yet been processed, used with the results of this study may provide a good picture of Shad movement up to Vernon and through Vernon and in particular the near-field behavior monitored in this study.		
	Revise Study Plan	Revised SP.
B. What is the number of tagged shad necessary to reduce signal collisions? Is there a maximum? By releases groups or by total? Consider with respect to early, mid, and late season spawners.		
	Examine options for accommodating this. Revise Study Plan if necessary	Revised SP: The draft SP included 40 tags, agencies had suggested 100 and the plan has been revised accordingly.
C. Conservatively, TC should not count on radio tagged shad from Turners Falls.		
	Not a critical element in TC's study, but duly noted.	Revised SP for 100 tags. We still plan to try to get FL frequency info.
D. Better describe and illustrate the telemetry layout:, receivers locations, tracking coverage areas, fish ladder wiring and monitoring locations – both up and downstream. Identify all fixed receiver sights below Vernon, at Vernon and upstream of Vernon.		
	Revise Study Plan	Revised SP. Figures added to plan (see below) and layout clarified.
E. Study should be designed to reflect the entire shad run. Collecting and releasing shad from the early, middle and late run. Timing and breadth of the run should be captured. ***Potential data points to assess these periods include: historical returns - data and trends; real-time monitoring or actual counts at Holyoke; real-time temperature monitoring (First Light? and TC or Holyoke); good and active communication between TC and fishery agencies.***		
	Will consider and revise Study Plan as needed.	Revised SP: Unless 2012 data (when analyzed) indicates otherwise, we expect to tag 1/3, 1/3 and 1/3 in early, mid and late season, respectively. Consultation/communication with agencies is already part of the SP. Will monitor Holyoke to define early, middle, and late is.
F. Consider Mortality Tags vs what we are proposing.		
	Will consider and revise Study Plan as needed.	Revised SP to include temperature/mortality tags.

G. Provide better clarity, process, consultation and decision making associated with reviewing 2012 and possibly 2011 USGS study data to determine ultimately the final No. of tags, monitoring locations, source of fish and release points.		
	1. Better delineate the steps and time table 2. Propose criteria for decision making – this might be modified in the final SP following additional consultation (could add a comment in the revision to that effect) 3. Revise Study Plan	Revised SP. Expanded section on 2012 data review, including consultation after 2012 data is analyzed. We do not intend to review the 2011 data.
H. Include elements to better assess the impact on shad migration potentially caused by the Bellows Falls operation – both movement and spawning. Consider multiple fixed receiver locations below Bellows Falls.		
	Will consider and revise Study Plan as needed.	Revised SP. Added one monitor in Bellows Falls bypassed reach and one monitor in the Bellows Falls tailwaters - see Figure 21-2.
I. Numbers of radio tagged fish released as "late season" representatives may need to be greater than numbers of the previous early and middle representative fish due to inherent late season mortality or fatigue in order to capture a reasonable sample population size to observe.		
	Will consider and revise Study Plan as needed.	Revised SP Unless 2012 data (when analyzed) indicates otherwise, we expect to tag 1/3, 1/3 and 1/3 in early, mid and late season, respectively. The increased number of fish proposed (in B above) should alleviate this concern.

J. ***a. If we use Holyoke fish and release them or some of them above TF would we be able to detect their potential downstream movement at TF?*** ***b. Describe in the SP how we could coordinate and share tag specifications: tag codes, pulse rates, frequencies, receivers with FL to reduce signal collision and expand tracking network and numbers of overall tagged fish for both studies.*** ***c. Is there any value in releasing a portion of the fish into the canal or below TF as well as above TF?***		
	Will consider and revise Study Plan as needed.	No changes in SP at this time. a. TC and FirstLight would each be able to detect those fish within their respective studies. b. Sharing of info/tracking is included in the SP. However, it is too early for detailed discussions with FL on how that will happen, but both companies have agreed in principle to share information. c. For purposes of TC's study there is no value in this request, this should be requested of FL for their studies.
K. Consider adding language in the SP with respect to criteria or reasons that would warrant repeating all or portions of Study No.21 in a second season.		
	Will consider and revise Study Plan as needed.	No changes in SP at this time. We feel that a single study year is sufficient. An additional study year would be subject to FERC's review of the year 1 study results.
L. Non-commented revision to the SP for discussion		
	Upon further consideration, TransCanada does not believe it likely that we can adequately discern potential effects from either Vermont Yankee or Bellows Falls operations from Vernon Project effects in a meaningful way, as was originally included in agency proposed study objectives in the draft Study Plan.	Revised SP as proposed here: Since this study is intended to assess shad movement through all project and riverine waters from Vernon to Bellows Falls, the relevant revised objectives of the study are to: • assess upstream migration from Vernon dam (overall); • assess post-spawn downstream migration route selection, passage efficiency, downstream passage timing/residence and survival related to the Vernon Project.

22. DOWNSTREAM MIGRATION OF JUVENILE AMERICAN SHAD – VERNON

<table>
<tr><td colspan="3">A. Consider using hydro-acoustic (HA) assessment technology in this study. Set up an array in the forebay at Vernon to enable monitoring of the run with respect to seasonality, flow conditions, temperature conditions.</td></tr>
<tr><td></td><td>Will consider and revise Study Plan as needed.
We recognize the desire to evaluate all three types of turbines. This is still being considered internally and will be fleshed out in final study plan based on internal discussions.</td><td>Revised SP as proposed here:

We propose to use underwater cameras as a better alternative to hydro acoustics which have limitations including being subject to interference from underwater noise from generation and a lack of ability to distinguish between species. Cameras in the bypass are a better solution here. HA has been looked at but it requires significant cost and effort if we are just looking at timing of outmigration.</td></tr>
<tr><td colspan="3">B. We should be evaluating survival through <u>all units</u> which we currently are not proposing. (see comment C below)</td></tr>
<tr><td></td><td>Will consider and revise Study Plan as needed.</td><td>No changes in SP at this time.

There are three types of turbines and the previous juvenile shad test Unit 10 eliminates the need to study one type. We propose to test the two turbine types that have not been tested before.</td></tr>
<tr><td colspan="3">C. Study Plan should describe Vernon operation more clearly in terms of:
1. unit priority if such exists,
2. turbine specifications
3. Operational historic hydrograph, exceedance, operational unit type statistics during out-migration period (monthly perhaps)
And how this information could be used to support our proposal on how survival studies should be defined for all three unit types.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>Revised SP as proposed here:

This could be part of this study as it has not been studied within this context before. This work could be done in 2013 and presented for consultation with the aquatics working group to determine the final scope of the study in 2014 (per B above).</td></tr>
</table>

<table>
<tr><td colspan="3">D. Study Plan should provide better linkage as to how telemetry data on route selection might be used to refine a second season study focused on empirical survival through other unit types.</td></tr>
<tr><td></td><td>1. Consider how this might work and the criteria for making a determination of need for evaluating other units.
2. Together with operational analysis above, propose a metric and discuss with TC
3. Revise Study Plan to reflect this</td><td>No changes in SP at this time.

We are proposing a one year study only, based on B and C above.</td></tr>
<tr><td colspan="3">E. On page 158 second to last paragraph, change the word “retained” to “reported”.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>Revised SP.</td></tr>
<tr><td colspan="3">F. Consider the effect of project operations on the apparent thermal conditions associated with Vermont Yankee’s (VY) discharge – particularly when they are allowed to increase the discharge temp in the fall.

How might the Study Plan assess the impact of operations on migration of shad through the project considering the VY thermal discharge or plume.</td></tr>
<tr><td></td><td>Will consider and revise Study Plan as needed.
We are looking at collecting additional water temperature data downstream of the VY plume.</td><td>No changes in SP at this time.

As part of temperature being monitored in several studies including Study 6 – Water Quality,
we will be installing temperature monitors upstream, downstream and in the fish ladder for purposes of several studies.</td></tr>
</table>

23. FISH IMPINGEMENT, ENTRAINMENT, AND SURVIVAL STUDY

A. Provide more detail and clarification on the process and analytical methods used throughout the aspects of this study (desktop entrainment as well as EPRI survival studies that will be used as reference).		
	Revise Study Plan	Revised SP
B. SP should include quantification on mortality on a particular species population.		
	Advised in SP mtg. was that was not the stated intent of the study to develop an assessment and determination on the entire population.	Revised SP Plan clarified that study goals/objectives do not include quantification of mortality of species, but to provide a qualitative assessment of probability of entrainment/impingement and quantitative estimate of the number of individuals affected.
C. To the extent that the EPRI dataset includes American shad and American eel, cross reference it with TC's survival studies of these species (Studies 22 and 19) and use in desktop analysis.		
	Revise Study Plan	Revised SP Clarified to include EPRI results and other TC studies

24. DWARF WEDGEMUSSEL AND CO-OCCURRING MUSSEL STUDY

A. Which phases or Tasks in 2013 vs 2014?		
	Clarify in SP	Revised SP Task 1 and 2 and pilot for task 4 will be done in 2013.
B. Question about Wilder riverine section.		
	We are trying to fill in the remaining gap that wasn't done in 2011 to get a full data set from which to evaluate further via tasks 2 and beyond. There is additional historical data to pull together also. Task 2 will include additional evaluation in certain locations.	Noted, no changes in plan as this is already included in the SP.
C. What is the density level required to reasonably perform the quantitative survey?		
	Clarify plan – how we would develop a quantitative survey. What criteria are critical for determining a design for a quantitative survey?	Revised SP Plan clarified that this could be part of Task 5 which cannot be fully scoped at this time, pending Tasks 1-4. Certain methods work better for low, medium, or high density populations. Until populations are characterized can't really answer this question accurately.
D. What data will you have to use to determine what project effects are, if you don't do the more detailed quantitative sampling evaluation.		
	Clarify in plan the need to do phase 1, look at population densities etc, before saying how we'd go about that. The population is what it is, if population is too low to do a study, we may still be able to glean some information, but we don't know yet.	Revised SP See C above. Where mussels are and density of populations will determine nature of quantitative sampling.
E. JR – can we add to the plan to identify the criteria or what are important elements that would drive a quantitative survey? E.g., what kind of things are critical?		
	Clarify the study plan for thought process for what will be necessary to make that determination.	Revised SP See C above
F. With regard to looking at smaller less robust populations also need to be selected.		
	Clarify the study plan. There are certain methods and analyses that work for smaller populations that are more qualitative vs. methods and analyses for larger populations.	Revised SP See C above. 2013 surveys will help to answer this question.

G. Qualitative monitoring does not preclude evaluating project effects, quantitative and habitat analysis isn't really needed. May be an ongoing monitoring over time as part of license condition. Same thing with in situ behavioral study.		
	Develop task 5 in study plan further to clarify and be more specific relative to : Instream flow study (Habitat evaluation (HSIs) don't work for mussels since they over predict where mussels would be); Hydraulic modeling, How to tease out the project operational effect, and hard to draw any kind of conclusion with small populations.	Revised SP Noted, and plan clarified that Task 5 is premature to scope at this point.
H. is there a reference population?		
	Not in the project area. There is one further north in the CT river but that area does not have daily fluctuating flows.	No change in plan

25. DRAGONFLY AND DAMSELFLY INVENTORY AND ASSESSMENT

<table>
<tr><td colspan="3">A. Could we incorporate an assessment of the rate of movement or climb as adults emerge and climb the banks. Try to get best observational estimate of movement while on site?</td></tr>
<tr><td></td><td>We can include this – keep an eye on a few individuals to see where they move (use pin flags etc).</td><td>Revised SP

Depends on timing and if we find mature larvae emerging and will revisit the site.</td></tr>
<tr><td colspan="3">B. Include sites upstream of Wilder impoundment for a evaluation of non-project effects versus project effects.</td></tr>
<tr><td></td><td>We may consider this but the baseline is the existing project not non-project. We will examine effects though our modeling and determination of operational impacts.</td><td>No change in plan, based on baseline conditions.</td></tr>
<tr><td colspan="3">C. Would like to see one more riverine site</td></tr>
<tr><td></td><td>Revise Plan if necessary</td><td>Revised SP

Added site just downstream of Vernon dam where odonates have been recorded.</td></tr>
<tr><td colspan="3">D. What data will be available for site selection?</td></tr>
<tr><td></td><td>Study 7 –Aquatic Habitat Mapping. Will include consultation/process for determination of study sites.
Clarify and revise SP</td><td>Revised SP
Clarified that Study 7 and Study 27 will help and final site selection will be done in consultation with the working group.</td></tr>
<tr><td colspan="3">E. Will the surveys be timed for a particular water level e.g. low elevation which can affect observations</td></tr>
<tr><td></td><td>We understand the concern.
Will try to go out during low water, but there is some variability in water level. We will work with operations staff to try and manage that.</td><td>Revised SP</td></tr>
<tr><td colspan="3">F. [M Ferguson] Define what units are being used (density, abundance)</td></tr>
<tr><td></td><td>Revise plan to include definitions of density and abundance</td><td>Revised SP

Added in analysis section.
Number/meter along transects, total counts by transect etc.</td></tr>
<tr><td colspan="3">G Final study report does not include relationships between other studies</td></tr>
<tr><td></td><td>Provide greater clarity and detail on how other studies that relate and will inform relative to project effects (e.g., modeling studies, habitat studies mentioned in the plan

This will be accomplished in each plan specific to the issue and then in the Environmental Report accompanying the license applications.</td><td>All applicable study plans revised as needed, based on information available at this time.
Study 7, 27 for site selection. Analysis from modeling, erosion and study 7.

See also Study 4 flow chart.</td></tr>
</table>

H. Evaluate or describe emergence and barriers to emergence (structural, hard barriers, e.g., riprap)		
	Intent of study is to characterize the population, not to evaluate those factors. Plan already includes observational data on bank conditions. We will not select those types of areas as study sites. Clarify plan for this.	Revised SP for clarity. Bank conditions/stability etc included in plan
I. What about food base for this species – can it be one of the parameters of the study		
	Revise plan to include as an observation.	Revised SP
J. Would be instructive and informative to include sites outside of baseline (e.g., pre operations) and outside of project influence for reference.		
	We are assessing the habitats and populations that are being affected by our operations. Going outside does not inform our project effects.	No change in plan
K. ***Include reach below Vernon***		
		Revised SP Additional site below Vernon included in plan, see C above.

26. COBBLESTONE AND PURITAN TIGER BEETLE SURVEY

A. Will these areas be included in the survey? 3 islands, state and privately owned below Wilder dam and above where cobblestone reported in the past. And other islands in Lebanon area. Slower moving water, mouth of Mascoma – flow slows and fine silt – for potential puritan locations.		
	Make sure SP indicates these areas are within study plan area. Revise as needed	No change in plan. These sites are not specifically spelled out in plan but are within the overall study area and will be included in the study.
B. Uncertainty about whether frequent inundation might cause behavioral changes e.g., feeding patterns, burrowing stage (current inundation language in plan). Effects of repeated inundation or frequency of such versus a more natural hydrologic exposure should be examined.		
	Clarify association with hydraulic and operations model to examine exposure to inundation, frequency and whether or not this is within operational range. Revise plan for clarity on this relative to analysis	Revised SP
C. Methods: would we observe both larval and adult stages during site visits? Observations during flight period and looking for larval burrows at same time? Not sure that larval burrows would be present during adult flight		
	Clarify plan on this point about life stages.	Revised SP Plan includes 3 visits to help cover that. And both could occur at the same time.
D. Will you examine high quality suitable (but not necessarily occupied) habitat and be able to identify operational impacts, hydrologic changes. Would these become an econode with a goal of preserving optimal habitat even if no population is there now. Suggest prioritize known locations and good habitat.		
	Clarify in SP that goal is to identify suitable habitat and to link hydraulic model with locations of habitat.	Revised SP We will note locations and monitor elevations using pressure transducers as needed. However, “preserving habitat” is mitigation/enhancement not assessment of project effects and is therefore not included in the plan. We will identify and note the high quality habitat. There are many variables on the river, and we will extrapolate characteristics of known sites to other habitats, but may not be able to account for all characteristics

E. What would you do if you found PTB together with Common or Cobblestone TB?		
	Clarify this in SP	Revised SP We would immediately contact USFWS for further direction.
F. How to mark the individuals to prevent repeat counts?		
	SP will note options to prevent repeated counting; marking insects or marking burrows. Revise plan if necessary?	Revised SP We are concerned about potential mortality/injury by marking and do not believe we will find many. Mark Furgeson of VANR concurred by phone, given the other methods to be used (based on his written comments presented at the study meeting).
G. P. 189 Methods for identifying habitat –searches should also be done at low pond levels		
	Revise plan for clarity on this page 189 as to how we will access and look for suitable habitat during low flows or low water elevation conditions.	Revised SP
H. Combine with dragonfly study?		
	Our goal is to combine whatever field work we can to be as efficient as possible.	Revised SP Noted in associated studies.
I. Town of Plainfield has designated cobblestone as the town insect		
	Duly noted. Found on Burnap's island according to the town's information.	No changes in SP. Not included in plan specifically, but this will be referenced in the study report and license application as applicable.
J. Don't get side tracked by counting common beetles vs. cobblestone and puritan. Look at comparative or relative population estimate only for Common TB's.		
	Revise plan	Revised SP 1. SP clarified for non-disturbance. 2. We don't feel this is feasible to evaluate, as there is no other study we are aware of that correlates impoundment levels/flows and ice scour – no change in plan.
K. Don't disturb individuals and/or burrows, f they are laying eggs, to determine sex.		
	Revise plan to address this concern	Revised SP
L. Don't excavate additional burrows at same sites once we find 10 and excavate 1.		
	Revise plan to address this concern	Revised SP If we find 10 or more, we will excavate only 1 with goal to collect a larva for identification.

M. Will need endangered/threatened permit in Vermont (and in NH)		
	Revise plan to address this concern	Revised SP
N. Report should address how impoundments affect natural processes that affect habitat (e.g. ice scour). This might also include how operations affect natural processes downstream of dams also.		
	Revise plan to address this concern	We understand the question, but have revised the SP to look at those processes and they appear relevant we will take note.

27. FLOODPLAIN, WETLAND, RIPARIAN, AND LITTORAL VEGETATION HABITATS STUDY

A. Christian Marks in TNC has floodplain definitions		
	We can clarify the plan if needed. Our intent was more broadly defined. Revise SP to make that clear	Revised SP Defined for purposes of this plan. Identifying broad floodplain types (forests, modified, historic)
B. Will we geo-reference wildlife observations?		
	Clarify plan to say we will geo-reference everything we encounter (e.g., wildlife, roosting trees for eagles etc.)	Revised SP.
C. Clarify and detail the database, list and basis for identification of all occurrences of invasive species. What is the list we will use from which ID's will be made? How if subsampling habitats, how we will get adequate information on invasive species?		
	Either include invasive species list in study plan or how and when the list will be developed. (per Brett, FL used a specific list) Clarify study plan.	Revised SP Plan clarified. The prior shoreline survey picked up many invasive species locations and other available data will be used to fill in gaps for subsampled sites. We will use the IPANE 2012 list. Primarily through mapping phase but also through field observations. If we find a patch, we will GPS start/stop or create polygon. If more diffuse patch we will GPS perimeter in general. And use shoreline survey as a starting point.
D. Suggest that Lebanon NRI data and mist communities report data be included in license application. (see the email from Shelly Hatfield 06/06/13).		
		Revised SP Clarified plan in general referring to reviewing available town Natural Resource Inventories where available.

E. Identify high quality, high value natural communities and include them in the set of representative sites for site characterization (collect baseline info on species composition, diversity, richness, abundance) even if on private lands.		
	Will take this into consideration if there are any within the 200 feet of areas affected by the project.	Revised SP Will obtain 2014 database from the states and will check those areas. This study is not intending to repeat or expand the 2012 RTE study. Relative to the 200-ft area only and to the extent of hydraulically connected wetland or floodplain and prior work. The areas we want to represent are those affected by project operations, which are mostly owned by TC.
F. Include an assessment of riparian buffers or lack of buffers on TC land and any others surveyed – e.g., agricultural lands		
		Revised SP Included specifically in analysis section of plan
G. Will we include surveying of floodplains and wetlands where river has been cut down (due to erosion) and cut off or disconnected from the floodplain (not getting floodplain and floodplain access as a result).		
	Clarify in SP that they will be characterized, as will everything for at least the 200 ft.	Revised SP Will note those areas, but not looking for them specifically. They should become apparent through this study and through the erosion study. If they are historic floodplains, it will depend on what we see and what their elevations are, to determine what category they are put in (historic floodplain).
H. CT river is IBA – Important Bird Area (NH, VT and national Audubon) along the 200' above sea level contour msl. (From Weathersfield downstream.)		
	Will consider and revise plan if needed.	No change in the SP. All incidental bird observations will be noted. The IBA designation was mentioned in the PADs and will be in the license applications.

I – Identify vernal pools, esp. in relation to fowler's toad study?		
	Clarify in SP	Revised SP We are not doing an official vernal pool survey, but they will be noted from aerial photos and field work. Most of the field season will be outside of the vernal pool season, but professional judgment will be used to note them. They will be identified if within the 200' extent and to the extent of hydraulically connected wetland or floodplain of the study area.
J. Reference any RTE sites noted in the RTE study as special habitats in this Study – cross reference these two studies		
		Revised SP They will be identified if within the 200' and the hydraulically connected wetland and floodplain extent of the study area.
K. Include entire 100-year floodplain mapping?		
	No - we are not trying to do an NRI of the CT river, and not doing a mapping exercise of the whole river, we are focusing on project effects under existing project conditions only.	No plan change Focused on 200-ft buffer and wetlands and floodplains that are hydraulically connected and within the range of project influence.

28. FOWLER'S TOAD SURVEY

<table>
<tr><td colspan="3">A. Provide more clarity on the descriptions of the habitat that will be recorded: date and time; elevation, and elevation in relation to water, proximity to water, adjacent and local vegetation, soils…</td></tr>
<tr><td></td><td>Clarify in SP</td><td>Revised SP

When we find a site we will evaluate habitat – field document conditions, elevation of pool, etc.</td></tr>
<tr><td colspan="3">B. [Jim Andrews, Reptologist, Middlebury College] written comments
1. SP study area should include downstream of Vernon, to upper extent of Turners Falls impoundment. There is a recent record of the toad there.
2. SP should include small gravelly pools along shoreline/river margins
3. Air temperature should be recorded in addition to water temp, and best above 17.8 C for calling activity.
4. May want to extend study into July vs. June due to air temperatures?
5. Continue to recommend wet road searches using FrogLoggers, wildlife acoustics. Suggest going beyond just calling surveys.
6. Consider subcontract with local biologist, eg for Stebbins road in Vernon
7. Species may be listed as state endangered by 2014 and relevant data may be available through that process.</td></tr>
<tr><td></td><td>Will consider and revise plan as needed.</td><td>Revised SP after speaking with Jim Andrews.

1. As in other studies, approximately 1.5 miles below Vernon dam will be included. The one site identified may be off project lands, but will look at it.
2. Plan clarified
3. Plan clarified
4. Plan revised
5. Included in plan as a possibility depending upon extent of habitat encountered and/or observations. If needed, we may put out recorders during period when we are not onsite.
6. Will consider, but not included in study plan.
7. Plan revised</td></tr>
</table>

C. ***1. Species preference for longer hydro-period*** ***2. SP doesn't include suitable habitat hydraulically connected to the project, irrespective of fee ownership.*** 3. ***Does plan include vernal pool decontamination?***		
	Will consider and revise plan as needed.	Revised SP. 1. Study goals include understanding of this effect, and clarify SP for recording water temperature. 2. Will consider inland areas including flowage areas that are suitable habitat and are hydraulically connected. 3. We are aware of VT (and NH) de-contamination practices and will compare to Normandeau's practices. Plan clarified.
D. Survey in Upper Meadows site - those areas that may not be directly tied hydraulically.		
	Will consider, based on suitability of habitat.	No change in plan as this area is inherently included already.
E. By the time we get out into the field in 2014; this species is likely to be listed as State endangered. – will need a public and a confidential report		
	Add public/confidential relative to potential listing of the species in the SP deliverables section.	Revised SP. Noted in the plan.

29. NORTHEASTERN BULRUSH SURVEY

<table>
<tr><td colspan="3">A. MAF Comment -</td></tr>
<tr><td></td><td>Sarah mentioned in her summary that bulrush is listed in NH and VT – revise SP to state this.</td><td>Revised SP.

State designations added into plan and the need for permits acknowledged therein.</td></tr>
<tr><td colspan="3">B. Recommend shift schedule to August thru Sept for fruiting season</td></tr>
<tr><td></td><td>Revise SP for schedule and methods</td><td>Revised SP.</td></tr>
<tr><td colspan="3">C.
1. What habitat parameters will be noted, including companion species?
2. How will you identify hybrids?
3. How would you conduct surface and groundwater assessments (in SP)
4. A one year study doesn’t confirm that the species is not present, due to dormancy.</td></tr>
<tr><td></td><td>Will consider and revise plan as needed.</td><td>Revised SP.
1. Habitat parameters we will collect included – vegetation communities, substrate, evidence of disturbance, land use, surface inflows (WQ, erosion, beaver activity etc). .
2. It is a tricky plant to identify habitats for. We will focus on known habitats and try to glean information from FWS and states. We may collect specimens with collections permit. Will collect fruit and photo-document the plant.
3. This is a qualitative assessment, we are not proposing to collect water quality data, more to identify overall conditions. Goal of this data would be to understand sources and important influences of hydrologic inputs to the site.
4. We will be identifying and evaluating suitable habitat that can be used in the future.</td></tr>
<tr><td colspan="3">D. How will project operation impact assessment be conducted?</td></tr>
<tr><td></td><td>Clarify Qualitative Evaluation process in Study plan; associated with hydraulic and operations model; pressure transducers (hobo’s) etc.</td><td>Revised SP.

Plan revised generally by reference to the modeling plans. Since bulrush was not found in the 2012 RTE study, it is unlikely that it would be found in areas impacted by flow related operations. We will evaluate that based on observations and habitat including land use, disturbances, etc.</td></tr>
</table>

30. RECREATION FACILITY INVENTORY AND USE & NEEDS ASSESSMENT

A. Define "vicinity of the project", and could additional properties be listed?		
		Revised SP. Includes inventory of the riverine sites between project boundaries. Full list of inventory sites in revised SP; on-site interviews have yet to be specified in SP.
B. Missing sites: Within Wilder project – chambers park and cole park adjacent to each other on conservation lands that abut the river just south of Hanover town line. – have trails, picnicking and swimming. And 3 others to propose – just south of project boundary Westboro area (proposed cartop), 2 Rivers park (mouth of Mascoma with developed trail systems), and True's Landing (cartop NHFG access).		
	We will consider adding these to the SP.	Revised SP. These sites included.
C. a) Inventory form – suggest add assessment for suitability for carry in capability within the existing sites. b) What standards are being used for site condition evaluation – measuring good/fair/poor (e.g, amenities at campsites).		
	a) Revise SP b) We recognize variability among types of amenities, somewhat subjective, will document with photos.	Revised SP. inventory form updated for carry in capabilities as well as refined the site condition and human use evaluation forms
D. SP does not include areas between the projects (riverine sections), affected by project ops. Also FERC – those facilities may have unique questions.		
	We will review the list, and take input and consider adding for purposes of inventory.	Revised SP (see A above). Adjustments made to mail questionnaire to accommodate differences in those areas.
E. NHFG owns car top site at Cold River/Westminster bridge.		
	We will review the list, and take input on additional sites to revise SP.	Revised SP. All the sites in the "Connecticut River Boating Guide" have been added; mostly sites between projects.
F. Suggest – at River Park (Lebanon) requires public access (inc. planned boat launch and parking) to the river not built yet, but part of master plan with opportunity for trail network.		
	Phase 2 of SP includes use and needs assessment where this would come in.	No changes in plan. Overall process allows us to consider these in future and in study report.

G. Suggest adding ice fishing to under fishing portion of evaluation form		
	Will add to SP relative to river access.	Revised SP - forms.
H. Inventory form – add view points, pull offs etc. (e.g., CT River birding trail, wildlife watching, etc)		
	Will add to SP	Revised SP - forms.
I. Identify ownership (TC, public, private, state) on inventory form		
	Already on form.	No change in plan or forms Will also be in study report and license applications
J. Site condition form –should include evaluation of environmental conditions in place (riparian buffers, erosion, run off, etc)		
	Will add environmental conditions as one of the variables	Revised SP - forms.
K. Site condition form – include observations of over use, mis-use, etc. from the perspective of the river and its health, not the car being parked. How is access being dealt with?		
	We can try to clarify SP forms for good, fair, poor. Can add another variable of "environmental" (see J above). Add prompts for the surveyor, and add notes column.	Revised SP - forms.
L. Study should include winter/off season (ice fishing, late/early season fishing, snowmobiling, hunting etc) beyond Sept 30th (also peak foliage)		
	Will consider and revise SP as needed.	We are still looking at options to address this comment.
M. Inventory form relative to signage – including invasives, no wake zones, and other environmental impact issues.		
	"Signs" on the form refers to the inventory baseline – what signs are there now and photos. Add to form – list the signs that are present.	Revised SP - forms. Added comment via email from Lebanon about documenting public safety warning signs also will be included.
N. What about youth users?		
		Revised SP - forms. Youth will be counted, but not interviewed. Survey interview age changed from 18 to 16 as used by NHFG and SCORPs
O. Would like to see 2 year study,		
	There is a FERC requirement to review after first year. We are not currently suggesting more than 1 year, if proposing a 2nd year at this time. The process will determine if revisiting after the first year is needed.	No change in plan. Study process allows for review after first year.

P. Suggest capture other users that are not present via NGO's, towns, school groups etc. e.g., targeted surveys to known user groups (rather than random mail survey).		
	Need to minimize bias in those surveys. Will get greater response. How do you expand that to the larger general population and what conclusions can be drawn?	Revised SP. We are proposing a mail survey to a random set of people within the counties adjacent to the 3 projects. Firms sell mailing lists we can purchase and do a mass mailing with the option to return a hard copy (coded surveys) or log onto a version of the survey on the web.
Q. Future use projection – would like to see some new research done related to this region		
	There are processes in place for this, e.g., in state SCORPs, also within rec. mgmt. plans.	No change in plan.
R. Do any mailed surveys including the non-user of the CT river?		
	Will consider and revise Study Plan as needed.	Revised SP and forms. Potential or uncommon visitor section of SP addresses that via initial letter, survey, follow-up and internet survey. Survey form revised to adjust questions relative to non-user. See P above.
S. Suggest – from fisheries perspective, anglers using boat ramps etc. ***1. List sites will be inventoried*** ***2. Maintenance schedule for TC facilities*** ***3. Mailing – add "are you a member of a bass tournament club"*** ***4. Mailing – add "have fluctuating water levels ever impacted your recreation; are current fluctuations too much, enough, too little, etc" (flow and elevation)***		
	Can describe/add these items in SP and incorporate into study.	Revised SP and forms.
T. Provide more definition of "all activities" and groups in the SP (CRJC provided a list). ***CRJC recreation plan for the river – should become part of references.***		
	Will address these. CRJC plan was in PAD	Revised SP.

U. FERC suggests before next meeting – ***1. SP has sentence about BF shorter portage (p 218 top paragraph) – how might this be determined?*** ***2. User sampling – would like more detail on sampling breakdown*** ***3. More detail on "mixed model" of mail versus internet surveys – how many sending out.*** ***4. Traffic counters – outline which sites will and will not***		
	• Clarify process on portage alternatives (all) • Determine am/pm time breakpoints. And look to extend am/pm to account for early/late fishermen. • Will add more detail on mail/internet. • Add detail in SP to when ID of traffic counter locations can occur. • Also reference to use	Revised SP and forms. Many of these were described on the hard copy handouts which are now included in the final SP. Intent is to get a traffic counter at every site we want to interview, if the site allows for that.

31. WHITEWATER BOATING FLOW ASSESSMENT - BELLOWS FALLS AND SUMNER FALLS

A. Sumner Falls – if flows are diminished due to RTE species, seeking mitigation elsewhere esp at BF		
	Duly noted.	No change in plan.
B. Sumner Falls – number of boaters for study/form. Level 2 assessment says 2-4 boaters would be used, but did not identify No. of boaters in Level 3.		
	Need a reasonable number of boaters. Currently says "minimum" of 2 to 4.	Revised SP. • BF on-land assessment 2-4 expert boaters (consistent w/literature) • BF on-water, single flow assessment 2-4 expert boaters (consistent w/literature) • BF on-water, multiple flow assessment 2-4 expert boaters. • Sumner Falls: interviews & on-land assessment 2-4 boaters by type (e.g,, canoe & kayak) • Sumner Falls: on-water assessment 8-12 boaters ranging from intermediate, advanced and expert.
C. Sumner Falls comment relative to flows and naming of waves		
		No change in plan This will be captured in the study report
D. Sumner Falls – based on Whittaker's methodology.		
	Will review and consider in plan.	No change in plan. Yes, Whittaker and Shelby is already referenced in the plan.

E. Bellows Falls – barrier dam should ultimately be removed. Propose as part of study, to form a subgroup to look at feasibility of removal or modification.		
		No change in plan. We are not proposing any construction, permitting or removal of the dam during this study phase. There may be many considerations for the dam positive and negative relative to other resources and we feel we can assess flows without removal.
F. Want whitewater park ultimately, need to ask someone who has done this as part of evaluation of flows – useful to evaluate early.		
		No change in plan. This is premature. We need to evaluate the need for water boating resource first, and if FERC determines that whitewater flows or a park are needed, that would be mitigation.
G. Evaluation forms – please allow AMC/NEF/AR review them and more communication with TC		
		Revised SP – forms included. Forms will be included in final SP's. Stakeholders will have many opportunities to work with TC on this process.
H. For controlled flow test, how will boaters access river? Need to take care especially at barrier dam during the test.		
	Will clarify in SP	Revised SP. We propose Bellows Falls Level 2 on-land survey of 2-4 expert boaters first to assess safety, suggest initial boat test flow. We will proceed (if possible) to on-water assessment of a single flow based on the recommendation of that group. Then, if more flows are needed we will do multiple boat trips at various flows. This is a stepwise process.
I. Other potential take outs, below BF WWT plant would lengthen the run.		
	Need to check with owners of that land. Other places include at the existing portage put in on NH side and other opportunities to take out.	No change in plan. Study Plan No.30 will look at the portage route and alternatives upstream & downstream, and will be evaluated in this Study

32. BELLOWS FALLS AESTHETIC FLOW STUDY

A. Survey forms (handouts) similar to those used for whitewater, suggest coordinate study with whitewater		
		No change in plan. We recognize the opportunity to leverage demonstration flows for multiple studies.
B. Add 2 key observation points at constriction points within bypass – more dynamic.		
		No change in plan. This study is for aesthetics not whitewater boating and public viewing is not available generally from these locations.
C. Specify how to advertise controlled flows?		
	Will include in study plan, along with where locations for observation will be.	Revised SP. Key observation points are identified in the SP. Study leads will convene a focus group comprised of individuals representative of different subpopulations who would likely see the bypassed reach.
D. Additional questions for survey to include aesthetics of the river bed, and other things.		
	We are focusing on aesthetics of flows but will consider additional questions relative to baseline. We will also be looking at flows for aquatics and for whitewater in other studies.	No change in plan at this time.
E. Tribal concerns over access to the river related to cultural, historical river access.		
	We are not putting anyone in the river for this study (only perhaps for Study 31, the whitewater assessment). Just identifying public viewing points. Most land around there is privately owned and TC does not have access.	Revised SP. All references to access into bypassed channel have been removed.
F. Arch Bridge is a viewing point and it gets a lot of foot traffic, and could be an observation point.		
		Revised SP. Moved key observation point 3 to the bridge.
G. Towns should be on list of interviewees		
	We need a cross section of people, not necessarily vested interested parties.	Revised SP. Process is outlined. See I below.

<table>
<tr><td colspan="3">H. How are you going to coordinate these studies?</td></tr>
<tr><td></td><td>Will provide clarity and process detail on coordination of all flow studies in the SP, but not sure it will work in practice, it is more important to make each process work for each study.</td><td>Revised SP.</td></tr>
<tr><td colspan="3">I. How will representatives will be chosen, particularly regional and non-local tourists. Need to be more definitive.</td></tr>
<tr><td></td><td></td><td>Revised SP.

We want a diverse population that is representative of different types of people. Looking for 8-10 participants who represent people who would view the bypassed reach and these people need to be objective (not have personal agendas or interests or be biased for their business or town revitalization efforts, etc).

TransCanada Community Relations, VANR and Rockingham Conservation Commission (study requests) will be contacted to nominate potential participants who could also nominate participants. We will use a networking approach.</td></tr>
<tr><td colspan="3">J. SP includes photos and videos, and onsite observations – how will you do this?</td></tr>
<tr><td></td><td>We lose some detail by offsite viewing of video/photos but those will be filed as proof of the flows on those days as a component of analysis and report of study.</td><td>Revised SP.
Hybrid approach:
We propose to collect the photo/video from now thru the demonstration flows and organize a single offsite viewing focus group. This is the most efficient way to conduct this study. We can share photos/videos of spill events in all seasons and will get better turn out from our focus group.

There will be a field component that ‘shuttles’ the group to the 3 key observation points for context but will not ask them to view/score flows observed in the field. It will be too difficult and unnecessary to have the same group show up multiple days in a row.</td></tr>
<tr><td colspan="3">K. Questions 15, 16 of survey – relative to “which flow level” and “at which level of flow”</td></tr>
<tr><td></td><td>Can clarify in SP, for each key observation point and each specific flow. Need to also think about flows at dam, flows in bypass or both</td><td>Revised SP – forms.</td></tr>
</table>

L. Survey form – safety question – explain better.		
	Intended to gauge people's perception of safety relative to the key observation point. Clarify in the plan and survey form what we are looking for with this question.	Revised SP – forms. This question was deleted from the survey form. There is no intention to have public in the bypassed reach or create concerns for safety while viewing the bypassed reach. People are allowed to cross Arch and Villas bridge on foot. This study is not looking at safety along the portage route either.
M. Would these be seasonally adjusted flows? Icing could create icing /misting problems and unsafe conditions for pedestrians.		
	Dam safety issues are also of concern. Will consider in SP	Revised SP. Capturing spill events from now till next year should capture some winter spills w/ice & mist. These images would be used with the other images in the focus group survey.
N. There may a year round attraction where icing is aesthetic at waterfalls		
	Can consider in SP, but again there are dam safety issues.	See M. above

33. CULTURAL AND HISTORIC RESOURCES STUDY

Cultural and Historic Resources No. 33
TransCanada Cultural Resources Study Meeting
Web Conference – July 3, 2013
Meeting notes

Attendee List attached.

The purpose of this call was to discuss the proposed Project Area of Potential Effects (APE) with the Narragansett Tribe, Vermont and New Hampshire State Historic Preservation Offices, FERC, and TransCanada. Prior to the call, all parties received a copy of the current Cultural Resources Study Plan No. 33 and maps of the proposed APE.

(NOTE: Meeting started at 11:00 am (Eastern time). These are the notes of Alison Macdougall, the Louis Berger Group, who joined the call at 11:20. These notes reflect discussions from 11:20 forward.)

Howard Clark (Nolumbeka Project) and Scott Dillon (VT SHPO Office) – There are pictographs at the mouth of the West River that are currently inundated and are being eroded as a result of the project. What is TC planning to do about this impact?

Suzanne Chereau (PAL) - Confirmed that the pictographs are present.

Scott Dillon (VT SHPO) – We are concerned about the limits of the proposed APE. If the banks are eroding and moving, will the APE adjust accordingly?

John Ragonese (TC) – Yes, the APE is flexible and will follow the edge of the banks. This is why we will be monitoring them…to determine if cultural sites are being affected by that erosion.

Edna Feighner (NH SHPO Office) – Why was no testing of eroding sites undertaken?
John - We only completed a visual Phase IA study. Testing would be done as part of a Phase IB study.

Scott – TC should probably identify and evaluate all sites within ten meters (30 feet) of the flood pool. You are proposing to do more work, but it is not clear what the Phase IB study will entail. The HPMP should be completed after the eroding sites have been tested and evaluated. VT SHPO feels strongly that the identification effort has not been completed and that just monitoring is not appropriate. More needs to be done with these sites.

Steve Olausen (PAL) – We are not planning on identifying ahead of time all potential effects that could occur over fifty years. But we have a process to continue to monitor changes so that we can then determine what to do as it happens. We did the survey, now we need to discuss what additional steps need to be done…Phase IB etc.

Scott – We want to see identification and evaluation of sites that we know are being affected by erosion right now, not after a monitoring effort.

Steve - We plan to look at that, but just haven't' done it yet. All we have done is a visual IA survey.

Frank Winchell (FERC) – I have some questions. First, has a Phase IA been done for all three projects? Did you look at all three shorelines?

Suzanne – Yes, we looked at all of the shorelines by boat. Prior to that, we did site file research to obtain info about all of the known sites so that we could look at them in the field. We called that a Phase IA survey based on NH and VT guidelines for a Phase IA study.

Scott – Your Phase IA did not include testing, so it was not a complete Phase IA.

Suzanne - We did not do an identification effort using testing. We identified visually. So no, we could not identify all sites….only those we could see without testing.

Frank - (Referring to Bellows Falls APE Sheet 3 of 4 as an example). There are areas on this map that extend away from the shoreline. Did you survey these areas on foot using systematic transects?

Suzanne - Yes, we did a complete walkover but we did not use transects. But many of the areas were inundated and we accessed only those that we could.

Scott – Did you do surface collection? It was not a complete survey if you did not do a systematic surface collection.

Frank – At some point, the maps should clearly show where you went, what you did, and how.

Steve - (Referring to “Great Meadows” on Bellows Falls APE Sheet 3 of 4 owned by TC). They went to this area…do we need to mark exactly where we walked here and where we didn’t?

Suzanne – It was not possible for us to identify every site that is out there…much of that area was marshy and we could not get to it.

Frank - What is the next step then? We need to go to Phase IB. The outcome should be a comprehensive Phase 1 study that gives us a pretty good idea of what’s out there, including an understanding of what’s eligible for the National Register. Then the next step would be to include that information in a HPMP.

John – The project has a very limited fluctuation range. But we are currently doing studies to better understand project effects.

Scott – Do the marshy areas ever dry out?

John – No.

Joe Graveline (Nolumbeka Project) - The Phase IA study is not a valid Phase IA study because it does not address tribal interests. There was no tribal involvement in the study and your personnel had no knowledge of ceremonial areas and spiritual aspects when they did the fieldwork. You can’t determine the APE absent an understanding of traditional areas.
John - The TCP aspect is another element that may need to be investigated.

Frank – TC has done a pretty good Phase IA, which is just a part of the Phase 1 study. You will need to follow through with the rest of it and may need to get above the shoreline, get a better look at erosion, and ensure that the APE covers those areas.

Suzanne – We did not go on top of the shoreline on other private lands. Just on TC lands. John – We aren't convinced that the project is the primary cause of erosion. An erosion study is currently being done. We are identifying erosion, but we are not at the point where we will survey other private land (non TC) when erosion on those lands may or may not be project related. Should we extend the APE 30 feet beyond the shoreline even if we don't know if the erosion is caused by the project?

Frank – We are determining an Area of *Potential* Effects (emphasis on "potential"). It is just the area where there is the *potential* for project effects. But if there is an opportunity to get on top of that shoreline and take a look around, particularly in sensitive areas, then TC should do so.

John – We do not have a right to access other private lands.

Frank – Did you make an attempt to get access to those lands to see what is there?

John – If we didn't see anything on the shoreline, but get access to lands above it, what if we see an artifact 28 feet inland?

Frank - If a site extends from the shoreline inland 28 feet, then there is a connection to what is going on at the water's edge. But if there is nothing on the shoreline and you see an artifact 28 feet inland, then there may not be a connection between that artifact and the project. You have provided some good working APE maps. As long as the systematics are in place (what else needs to be done and how), you can observe and document effects, project-related or not. At some point, you may need to at least make an attempt to get on top of the shoreline on other private property based on the results of the Phase IA. You will need a clearcut methodology. Look at the Otter Creek Study Plan. It covers what I am looking for, and what the SHPOs are looking for as well.

John – Otter Creek is a much smaller scale project. We need to meet the cultural resource goals. We did a visual survey and identified a need for more work.

Scott - From the VT SHPO's perspective, we believe the work area has been limited by TC. The Study Plan does not include appropriate testing. We would not concur with the study plan if it does not include this process. TC needs to address actively eroding areas. The Study Plan does not identify where the Phase IB will take place nor does it address Phase 2 evaluation.

Edna - The NH SHPO concurs with Scott.

John – The current study plan does not specifically identify those areas for the IB but the process is described.

Scott - The only action identified is additional monitoring. We need a process for evaluation of eroding areas.

Doug Harris (Narragansett Tribe) – Tribal historic preservation is not being addressed. There needs to be an on-site examination. The studies you have done serve you and the archaeologists, but do not serve the tribe. You need to address tribal cultural values. We need to have "hands on" and were not invited to participate in the Phase IA.

John - We understand your position and have tried to keep you involved. We are interested in the on-ground tribal perspective. The APE is what we have in front of us and will require additional work, including the tribe's view. We are trying to identify the APE so that we can adjust it based on new information. Can you give us your input in writing so that we can make sure that we address it?

Doug – The tribe works directly with the Federal Agency, but we understand that TC can do some of the consulting. But the process “gallops” forward without us and without everything in place.

John – I understand. We have had discussions and are willing to do more. But we need something concrete from the tribe.

Doug – Are you willing to set aside a block of time to go into the field with the tribe?

John – Yes, but we need to know more about what that would entail. We need costs, personnel, tribal requirements, etc. We need to know exactly what the tribe wants to do so that we can determine if we can accommodate that request.

Doug – Would TC be willing to do underwater archaeology to assess the condition of the petroglyphs? They are being affected by inundation.

John – No. We have never done scuba surveys.

Doug – To us, those petroglyphs are significant and are being affected by the project. You will have our input by the end of next week.

Steve – We have revised the Study Plan based on Otter Creek. Please look at the last paragraph of the text and let us know if it is acceptable. The final determination of the APE Consultation among FERC, the VT and NH SHPOs, Narragansett THPO, and other parties invited to participate in the Section 106 process, will be conducted during the summer of 2013. Based on this consultation, the FERC will make a final determination of the APEs for the Vernon, Bellows Falls, and Wilder Projects.

Frank – I have no problem with that paragraph, but will need to sit back and analyze it. The boundaries of an APE can change. We need to think of it as a “working APE.” The Revised Study Plan is due on August 15. You should seek SHPOs concurrence on the APE prior to filing it.

Frank – Just a note: Some testing can be put into the HPMP to be completed post-licensing. The HPMP should discuss: (1) what’s out there, (2) what’s being affected, (3) a sense of National Register eligibility, (4) plans for affected sites, and also (5) the built environment (standing structures, etc.)

Frank – Because there are no tribal lands within the project boundary, we do not need THPO concurrence, but the THPO still needs to be involved. We still need SHPO concurrence though.

Attendee List

Edna Feighner	NH SHPO Office
Scott Dillon	VT SHPO Office
Frank Winchell	FERC
John Ragonese	TransCanada
Lou Thompson	TransCanada
Steve Olausen	PAL
Suzanne Chereau	PAL
Doug Harris	Narragansett Tribe
Howard Clark	Nolumbeka Project
Joe Graveline	Nolumbeka Project
Nick Ettema	FERC
Rob Quiggle	HDR/DTA
Andrew Gast-Bay	City of Lebanon
Shelly Hatfield	City of Lebanon
Alison Macdougall	The Louis Berger Group

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TRANSCANADA HYDRO NORTHEAST INC.

Wilder Hydroelectric Project (FERC Project No. 1892-026)
Bellows Falls Hydroelectric Project (FERC Project No. 1855-045)
Vernon Hydroelectric Project (FERC Project No. 1904-073)

Revised Study Plan

Appendix D

Written Comments and Requests received by July 15, 2013

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LIST OF COMMENTERS

American Whitewater

Appalachian Mountain Club, Vermont River Conservancy, and Friends of the Connecticut River Paddler's Trail

City of Lebanon New Hampshire

Connecticut River Joint Commissions

Connecticut River Watershed Council

F. William, Jr. and Jennifer Lipfert

Narragansett Indian Tribal Historic Preservation Office

National Park Service

New England Flow

New Hampshire Department of Environmental Services

New Hampshire Fish and Game Department (2 letters)

The Nature Conservancy

The Nolumbeka Project (2 letters)

U.S. Fish and Wildlife Service

Vermont Agency of Natural Resources

Vermont Division for Historic Preservation, State Historic Preservation Office

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UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

TransCanada Hydro Northeast Inc. Wilder Project No. 1892
TransCanada Hydro Northeast Inc. Bellows Falls Project No. 1855
TransCanada Hydro Northeast Inc. Vernon Project No. 1904

AMERICAN WHITEWATER COMMENTS ON PROPOSED STUDY PLAN FOR THE WILDER PROJECT (NO. 1892), BELLOWS FALLS PROJECT (NO. 1855) AND VERNON PROJECT (NO. 1904) FILED BY TRANSCANADA HYDRO NORTHEAST INC. ON APRIL 15, 2013

American Whitewater submits these comments to FERC in response to the Proposed Study Plan for the Wilder, Bellows Falls and Vernon hydroelectric projects operated by TransCanada Hydro Northeast, Inc. Our organization has previously submitted comments and study requests asking the licensee to study the impact of its hydroelectric operations on the recreational opportunities available to non-motorized boaters -- whitewater boaters, multi-day through paddlers and flatwater paddlers -- in the project area.

American Whitewater has been engaged in the hydropower relicensing process for over 25 years and has worked with FERC and numerous licensees to study the impact of hydroelectric projects on recreational boating opportunities throughout New England. We have assisted with recreational facility and use assessments and controlled whitewater boating flow studies during the relicensing process on rivers throughout the region including the Deerfield, Kennebec, Rapid, Magalloway and Penobscot Rivers.

Based on our experience with the hydropower relicensing process in New England and elsewhere, we submit these comments to address the deficiencies in the licensee's proposed study plans and respectfully request that FERC direct the licensee to amend its proposed study plans to address these deficiencies, as follows:

General Comments

1. **The licensee's proposed study plans will not adequately assess the demand for non-motorized boating in the project area.**

The licensee plans to study the demand for whitewater boating in the project area, yet proposes no methodology whatsoever for assessing the demand. Interviewing existing recreational users in the project area about their interest in whitewater boating at the Sumner Falls/Hartland Rapids or in the natural bypassed reach at Bellows Falls will yield no meaningful data. Collecting data from fishermen, hikers, campers, and flatwater canoeists on their interest in whitewater boating would yield less accurate or useful data than would a survey of paddlers at the West River in Jamaica, Vermont where whitewater boaters gather for the one annual release day from the Ball Mountain Dam that provides boating opportunities for beginning and intermediate whitewater paddlers.

Existing recreational users in the project area are a self-selected group who utilize the facilities in the project area because they believe that the existing facilities are sufficiently adequate to meet their recreational needs. While some paddlers may have an interest in these forms of recreation, their primary interest is in whitewater boating, which, in the case of Bellows Falls, is not available in the project area due to the lack of sufficient water flows and lack of access in the natural bypassed reach. While some whitewater boaters frequent the Sumner Falls/Hartland Rapids below the Wilder Dam, this area is underutilized due to the lack of a release schedule that would provide consistent, predictable and sufficient flows. At Vernon, there is no whitewater boating because the project has drowned any rapids that would otherwise be found there. As such, few if any whitewater boaters will be found in any of the project areas, and surveying those users on their interest in whitewater boating will be a useless exercise. These boaters will be found elsewhere, such as on the Contoocook River in Henniker, NH, providing there is sufficient flow there.

If the licensee intends to study the demand for whitewater boating in the project area, then it needs to develop a methodology that will provide meaningful data. This methodology should include surveying boaters on the West and Contoocook rivers, collecting data from river outfitters, using internet-based surveys, and working with organizations such as American Whitewater, New England FLOW, and the Appalachian Mountain Club to survey their members' interest in paddling at Sumner Falls when there are predictable, consistent and sufficient flows, or at Bellows Falls once sufficient water has been restored to the natural bypassed reach to permit scheduled whitewater boating.

Likewise, the licensee's plan to study the demand for multi-day canoe and kayak trips on the Connecticut River will yield no meaningful data on the public's interest in paddling downriver on the Connecticut. The lack of an adequate portage trail at Bellows Falls, and the lack of adequate boat launch and camping facilities for through paddlers, have deterred many through paddlers from exploring this section of the Connecticut River. These paddlers must either paddle elsewhere where there are adequate facilities, or are unable to pursue their recreational interests. While the licensee proposes to conduct a random survey of 2400 area residents, this survey is too small to capture the interest in this specialized type of paddling by boaters who are likely to travel to the area from outside of the geographic area of this survey. Given that the Connecticut River and Watershed was designed as the nation's first National Blueway in 2012, the licensee needs to coordinate its study with FirstLight to determine the public's interest in through paddling on the Connecticut River. The National Blueways System has as its goal "to advance a whole river and watershed-wide approach to conservation, outdoor recreation, education, and sustainable economic opportunities in the watersheds in which we live, work, and play."

2. **The licensee's proposed study plans will not assess the extent to which the inadequacy of its recreational facilities diminishes the recreational opportunities in the project area.**

While the licensee proposes to conduct an inventory and assessment of the recreational facilities in the project area, it does not propose to survey non-users to determine whether the lack of adequate facilities has deterred or prevented them from pursuing their recreation interests in the project area. With regard to whitewater boating at Bellows Falls, the absence of sufficient flows in the natural bypassed reach (except during high water spillage events), the lack of adequate access points and parking, and the presence of rebar or other hazards has prevented all boating in the natural bypassed reach below the Bellows Falls Dam. In the case of Sumner Falls/Hartland Rapids, the licensee does not propose to survey non-users to determine whether the lack of adequate facilities at this section of the river below the Wilder Dam has discouraged use of this area. The licensee needs to include in its facility inventory and assessment, a discussion of the facilities, or lack thereof, for whitewater boating.

Likewise, the licensee needs to include in its facilities inventory and assessment, a discussion of the adequacy of ifs facilities for through paddlers in the project area. The licensee proposes to study only the adequacy of its recreational facilities for those who find the facilities sufficiently adequate to meet their needs. In order to determine what additional facilities may be needed, the licensee will need to tailor its survey to address the needs of those who may be unable to paddle the Connecticut River due to the absence or inadequacy of the facilities to meet their particular needs.

3. **The licensee has not sufficiently involved the boating community in the design and implementation of proposed recreation studies**

The licensee has not involved the boating community in the design and implementation of studies to collect data on the demand for whitewater boating or the adequacy of facilities to support whitewater boating at Bellows Falls or Sumner Falls/Hartland Rapids. Without the active involvement of organizations representing whitewater boaters, the licensee is in danger of underestimating demand for boating in the natural bypassed reach below the Bellows Falls Dam and at Sumner Falls/Hartland Rapids. By failing to sufficiently involve the boating community in the development of its study plans, the licensee may fail to adequately identify the obstacles to boating this section of the river. While the licensee has developed survey instruments as part of its user and facilities surveys, they have not sufficiently involved the boating community in the development of these instruments. Furthermore, their plan to collect data from users does not include any meaningful attempt to collect data from non-users. For example, the licensee does not propose to collect data from boaters on the West or Contoocook rivers where many boaters who are currently unable to paddle on the Connecticut River might otherwise be found. Had the licensee more fully included the boating community in the design and implementation of these surveys, it would have been able to collect more meaningful data than it would have otherwise been able to collect. The licensee should work with groups such as American Whitewater, New England FLOW, and the Appalachian Mountain Club to design surveys that will solicit the views of its members on the reason for non-use of project facilities. This will better inform the study process.

Similarly, the licensee has not involved organizations such as the Appalachian Mountain Club and the Connecticut River Watershed Council in the design and implementation of studies to determine the demand for multi-day canoe and kayak trip through the project area. As a result, the licensee is unlikely to collect sufficient data on the extent of the demand for through paddling and will fail to adequately identify the obstacles to use. The licensee should work with groups representing boaters interested in through paddlings on the Connecticut River to design and implement its studies in order to accurately identify the needs of these potential users.

Specific Comments

Study 30 Recreation Facility Inventory, Use & Needs Assessment (Updated 7/4/13)

The licensee states that one of the key objectives of this study is to "[p]rovide a general characterization of the white water-oriented recreational opportunities within the region." In order to accomplish this objective, the licensee intends to draw on information gathered from public recreation area visitors, residents from neighboring communities and less common user groups including, allegedly, whitewater boaters. The licensee's proposed methodology for collecting this data, however, does not propose any meaningful effort to survey whitewater boaters who would be best able to provide the licensee with useful information that would allow it to achieve its study objective.

The licensee's proposal to collect data from recreational area visitors will exclude virtually all users that are interested in whitewater boating because there are no whitewater boating opportunities at Bellows Falls due to the lack of water in the natural bypassed reach on any predictable, sufficient and consistent basis, and, due to the presence of certain impediments constructed by the licensee in the natural bypassed reach. At Vernon, there are no whitewater boaters because there are no whitewater boating opportunities due to the presence of the dam that has downed any potential boating opportunities there. At Sumner Falls/Hartland Rapids, there are fewer whitewater boaters because of the lack of predictable, sufficient and consistent flows. Surveying visitors at these locations will not yield meaningful data on the extent of the public's interest in whitewater boating because individuals interested in these activities are absent from the area because the licensee's operations have made whitewater boating difficult if not impossible in the project area. While some fishermen or motorized boaters may be interested in whitewater boating, the extent of their interest in this activity is likely less than that of the general population.

Likewise, the licensee's proposal to randomly survey 2400 residents of neighboring counties will fail to target a sufficient number of whitewater boaters to draw any meaningful conclusions about the demand for whitewater boating at these sites or the adequacy of existing facilities. As whitewater boaters have a specialized interest in these activities and often drive long distances to enjoy suitable boating opportunities, the licensee's proposal is unlikely to capture the perspective of these potential users. The licensee has no plans to survey users at other locations such as the West or Contoocook rivers, no plans to collect data from whitewater outfitters, no plans to work with organizations such as American Whitewater, New England FLOW, or the Appalachian Mountain Club to survey their members, no plans to develop internet-based survey of whitewater boaters, and no plans to conduct any focus groups to determine the extent of interest in boating in the project area.

While the licensee proposes to conduct user counts and maintains that this data will provide it with information on the recreation use at the project, this data will provide no information on the non-use of the project by whitewater boaters who cannot access the recreational opportunities due to the inadequacy of the facilities or the manner in which the licensee operates the project. The licensee simply ignores the request by FERC that it collect data on unique stakeholder groups such as whitewater boaters. Nothing in the licensee's study plan is designed to collect data on demand by non-users, including whitewater boaters and through paddlers, and licensee makes no attempt to identify the perceived adequacy of its facilities by these user groups.

Instead, the licensee proposes to collect data from the self-selected group of existing users on their interest in whitewater boating and canoeing/kayaking in its draft On-Site Intercept Survey, Potential Visitor Questionnaire (mail/internet survey), and Recreation Use Outside of Connecticut River Hydro Projects a.k.a ALTERNATIVE RECREATION AREAS survey to determine the demand for whitewater boating in the natural bypassed reach and the demand for multi-day canoeing and kayaking. The licensee offers no explanation for how these surveys will inform the process of identifying the demand for these activities or the need for improvements in its facilities. At best, these surveys will demonstrate that that there is limited interest in whitewater boating and through paddling by those who enjoy motorized boating or fishing in the project area. It will not, however, show the extent of the demand for these activities by those who go elsewhere due to the inadequacy of the recreational facilities to support these activities in the project area, such as the lack of water in the natural bypassed reach.

Study 31 Whitewater Boating Flow Assessment
(Updated 7/4/13)

American Whitewater supports efforts by the licensee to study the potential for enhancing whitewater boating at Sumner Falls/Hartland Rapids as well as in the natural bypassed reach at Bellows Falls, and credits the licensee for utilizing the study techniques recommended by by Whittaker et al., in “Flows and Recreation: A guide to studies for river professionals” (2005). We look forward to working with the licensee to refine its surveys and methodology in order to achieve the study objectives. Notwithstanding our general support for the licensee’s approach, our organizations have several concerns that should be addressed by the licensee.

We also acknowledge that the licensee has removed references to studying the demand for whitewater boating in Study 31; however, we remain concerned that the licensee intends to attempt to quantify demand without providing an adequate methodology for accomplishing this objective. To the extent that the licensee intends to incorporate demand for whitewater boating in this study, it needs to explain how it will accomplish this objective. A meaningful study of the demand for whitewater boating, if the licensee intends to study this issue, should include a survey of boaters on area rivers such as the West and Contoocook rivers, outreach on social media or message boards, internet-based surveys of paddlers, contacts with whitewater outfitters in the region, and outreach to organizations such as American Whitewater, New England FLOW, and the Appalachian Mountain Club to survey their members to determine their interest in whitewater boating in the project area. As such, a determination of demand for whitewater boating is premature at this point until the controlled flow study has been completed and optimal flows have been identified.

Demand is only one consideration in determining whether predictable, consistent and suitable whitewater flows should be provided to Sumner Falls/Hartland Raids and to the natural bypassed reach at Bellows Falls. Once a determination has been made that the natural bypassed reach is boatable at certain levels, FERC should require that the licensee provide scheduled releases in order to provide whitewater paddlers with the opportunity to enjoy this section of the river. Given that millions of people in Massachusetts, Connecticut, Vermont and New Hampshire live within several hours of Bellows Falls, and the fact that tens of thousands of people kayak, canoe and raft on surrounding rivers in the region, demand for paddling at Sumner Falls/ Hartland Rapids and in the natural bypassed reach at Bellows Falls can be presumed if suitable flows are provided.

The licensee further states in its proposed study plans that it intends to determine the number of days flows for whitewater boating are available under the projects’ current operation at both locations. While the licensee can make this determination at Wilder once optimal flows have been determined, it cannot make that determination at Bellows Falls. The current condition at Bellows Falls is that the licensee diverts approximately 40,000 cfs into the power canal for generation, spilling only “leakage” into the natural bypassed reach unless flows exceed its generating capacity. There is no flow in the natural bypassed reach at Bellows Falls on any consistent basis, and as a result, there is no basis for making this determination there. Instead, the licensee should examine the extent to which it is able to forego generation at Bellows Falls in order to provide boatable flows to the natural bypassed reach.

The licensee also raises the concern about the safety of boating in the bypass reach, citing instances of personal injury and accidents, including at least one fatality, due to public use or attempts at boating spill related flow in the bypassed reach. Safety has been a core issue for American Whitewater since 1954, and today we are leaders in accident analysis and safety education. We regularly advise legislative bodies and river managers on the best ways to educate whitewater users, which helps everyone enjoy our rivers safely. Formal risk management is part of all our programs enhancing safety and reducing liability risks for all.

American Whitewater maintains the most comprehensive accident database on whitewater boating, and regularly collects accident reports on injuries and fatalities resulting from whitewater flows. The accident database lists three incidents involving the Connecticut River as follows: (1) At Sumner Falls in 1991, a fatality involving a fisherman inexperienced with whitewater boating who drowned after his canoe capsized and his fishing waders filled with water; 2) At Northampton, MA in 2000, a fatality involving a man not wearing a PFD who was in an open canoe during the floodwaters following Hurricane Floyd; and 3) In Hanover, NH in 2010, a fatality involving a solo kayaker not wearing a PFD paddling in frigid high water in March. American Whitewater does not have any record of fatalities or other incidents having occurred at Bellows Falls. We are not aware of anyone having boated in the natural bypassed reach due to the near complete lack of access to this reach. Inexperienced boaters venture into whitewater and are often unprepared for the risks. We stress the importance of proper training and equipment for all whitewater boaters, but people continue to take reckless risks with tragic consequences. That being said, the bypass reach at Bellows Falls is like any other section of whitewater. Proper skill, training and information is required to safely boat this reach. Given that the licensee has no specific information regarding any incidents at Bellows Falls, it should base its study plan on known facts rather than presumed risks.

The licensee proposes to assess the presence, quality, access, flow information, and flow ratings for paddling opportunities in a stepwise manner. Significantly, the licensee plans to identify and document and assess any insurmountable risks prior to committing to on-water flow reconnaissance or controlled flow evaluations. American Whitewater classifies whitewater difficulty according to a scale ranging in increasing difficulty from Class I to Class VI. The level of difficulty on a particular river reach will vary depending on the flow. Whitewater rapids are considered unboatable if they are characterized with a Class VI difficulty. While American Whitewater recognizes that circumstances may require changes to the controlled flow study, we believe that the licensee should proceed to an on-water assessment unless the natural bypass reach is unboatable at any level.

The principal hazard in the natural bypass reach is the presence of the low-head dam that was presumably constructed by the licensee to prevent fish passage, likely by Atlantic Salmon, into the natural bypass reach instead of the fish ladder at the Bellows Falls Dam. Given that there are no Atlantic Salmon in the Connecticut River at Bellows Falls and the salmon restoration program has been abandoned after decades of effort and expense, the low-head dam likely serves no purpose and may be a hazard at certain flows. The licensee should be required to investigate the ownership, history and purpose of the low-head dam as part of its effort to study the restoration of flows into the natural bypass reach. The ability of whitewater boaters to use the natural bypass reach a lower flows that are compatible with other recreational uses may well be enhanced by the removal or the breaking of the dam, and the licensee should investigate the feasibility of doing so as part of this and other studies.

In order to enhance the whitewater boating opportunity at Bellows Falls, American Whitewater requested that the licensee study the feasibility of developing a whitewater park in the natural bypassed reach at Bellows Falls. The licensee has declined to study this possibility, claiming that this is a mitigation request. While modifications and enhancements to the natural bypassed reach are a form of mitigation, a study of the feasibility of a whitewater park should be included in the flow study because it bears on the recreational opportunities in the natural bypass reach as well as the compatibility of whitewater flows with other interests that may be seeking restoration of flows to the natural bypassed reach. As such, we renew our request that FERC direct the licensee to include a whitewater park feasibility study as an element of the controlled whitewater flow study.

Conclusion

American Whitewater respectfully requests that FERC accept these comments and direct the licensee to revise its proposed study plans to address the concerns raised. Thank you for considering these comments.

Respectfully submitted this 12th day of July, 2013

Bob Nasdor

Northeast Stewardship Director
American Whitewater
65 Blueberry Hill Lane
Sudbury, MA 01776

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

TransCanada Hydro Northeast Inc.	**Wilder Project No. 1892** **Bellows Falls Project No. 1855** **Vernon Project No. 1904**

CERTIFICATE OF SERVICE

Pursuant to Rule 2010 of the Commission's Rules of Practice and Procedure, I hereby certify that I have this day caused the foregoing **American Whitewater Comments on Proposed Study Plan for the Wilder Project (P-1892), Bellows Falls Project (P-1855) and Vernon Project (P-1904)** to be served upon each person designated on the official service list compiled by the Secretary in this proceeding.

Dated this 12th day of July, 2013.

Megan Hooker
American Whitewater

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

TransCanada Hydro Northeast, Inc.	Wilder Hydroelectric Project No. 1892-026 Bellows Falls Project No. 1855-045 Vernon Hydroelectric Project No. 1904-073

APPALACHIAN MOUNTAIN CLUB, VERMONT RIVER CONSERVANCY, AND THE FRIENDS OF THE CONNECTICUT RIVER PADDLERS' TRAIL'S
COMMENTS ON UPDATED PROPOSED STUDY PLANS
FOR THE WILDER HYDROELECTRIC PROJECT, FERC PROJECT NO. 1892-026, THE BELLOWS FALLS PROJECT, FERC NO. 1855-045, AND THE VERNON HYDROELECTRIC PROJECT, FERC. NO. 1904-073.

Since 1876, the Appalachian Mountain Club (AMC) has promoted the protection, enjoyment, and understanding of the mountains, forests, waters, and trails of the Appalachian region. The AMC is the largest conservation and recreation organization in the Northeast with more than 90,000 members, many of whom live within three hours of the Connecticut River and would enjoy these sections as a daylong or longer trip or as a whitewater opportunity.

The Vermont River Conservancy protects public access, wildlife habitat, clean waters, scenic natural beauty and ecological integrity by conserving undeveloped land along rivers, lakes and wetlands of Vermont.

The Friends of the Connecticut River Paddlers' Trail is dedicated to building and stewarding primitive campsites, access points, and portage trails along the Connecticut River. The organization manages over 30 campsites and 70 access points that reach from the Connecticut River's headwaters south to the Massachusetts border. Efforts are underway to expand the trail into Massachusetts and Connecticut.

Representatives of the Appalachian Mountain Club attended face-to-face sessions held by TransCanada on June 6 and 7, 2013, at White River Junction to discuss the proposed study plans. We reference our comments made at those meetings.

First of all, we want to compliment TransCanada for selecting qualified consultants to administer these studies. The consultants acknowledged our suggestions at the face-to-face meetings, were cooperative, and displayed a good knowledge of the river. Our comments below are intended to help them gather more and better data from their surveys and research.

Summary of comments:

In this filing, we emphasize that TransCanada, along with its survey of area residents and visitors, should expand their survey of non-users of the river. The survey should assess visitors' impressions of existing facilities, as well as learning why others may have been pushed away by a lack of recreation facilities, by facilities that are not suited to their forms of recreation, or because of undesirable river conditions, and so forth. In addition they should employ more qualitative forms of research such as focus groups. We suggest that the applicant consider a wider range of facilities and options in its inventory and assessment of recreation facilities. We make what we consider important comments about the portage trail around the Bellows Falls Dam, the whitewater boating study in the Sumner Falls reach and the Bellows Falls bypass reach, and about the failure of TransCanada to conduct a contingent valuation study.

Comments on specific studies:

Study #30, Recreation Facility Inventory and Use & Needs Assessment

We feel a wider range of facilities and options should be considered for the inventory assessment. As one example, when a concrete boat ramp is present at a put-in most inventories simply indicate a ramp. Concrete boat ramps, however, are generally most useful for people towing motorboats on trailers. Such ramps damage wood, fiberglass, and other kinds of car-top or self-propelled boats such as canoes, kayaks, small sailboats, and rowing shells. Put-ins that provide only ramps contribute to user conflicts as paddlers inevitably block the ramp while loading and unloading their boats, especially when carrying gear for multi-day trips.

The presence of a concrete boat ramp suggests the site favors motorboats. If, however, there is a sandy or wooden boat ramp, or a separate dock installed for paddle craft, then owners of self-propelled watercraft would find the site useful. If you ever have a chance to drive along the Charles River in Boston during the summer, you'll notice that the boat ramps from the grand boathouses on the Charles are made of wood. Such distinctions about access points could be helpful in this inventory.

At the meeting in White River Junction, we suggested surveying a wider group of users and especially of non-users of the TransCanada facilities. Expanding its survey of non-users can be helpful in identifying areas where TransCanada might strengthen its recreational facilities and offerings to serve a larger public. While some of this is planned, we encourage TransCanada to expand this survey of non-users.

Such surveys can be more cost effective and cover a wider audience by using mailing lists of NGOs, such as the AMC, which has thousands of members in the area and has a recreation plan for the Connecticut River Blueway. The AMC membership is so large that the only bias in the group is an interest in the outdoors and recreation, which would be a benefit in this kind of survey. Rather than securing lists of people who may have no interest in the river, it would be more efficient and informative to use NGO lists, where by definition the group has some interest. Ken Hogan of FERC commented to FirstLight that it is common in FERC processes to look at NGOs and municipalities that have recreation plans or development plans in the region.

We suggest that TransCanada engage in a broader range of survey techniques that produce more qualitative results and greater accuracy, such as focus group interviews. Such surveys are far more informative than paper surveys randomly handed out at recreation sites, but they do take a bit of time.

We are concerned about projecting future uses of the river using national models. Predictions of the future are always speculative, and using "standard sources" emphasizes regression to the mean rather than providing any useful information. We agree with Adam Beeco from FERC that more updated literature on doing future research is needed for this study.

We have questions about the standards employed to assess the sites already on the river. How is overcrowding measured, or even determined? Exactly what facilities would one expect to find at different kinds of campgrounds? We recommend looking at the extensive work done by the Connecticut River Paddlers' Trail to define what constitutes adequate campground frequency and equipment.

This is as good a time as any to mention the portage trail around the Bellows Falls Project. It is abysmal. The improvement of the portage may come under any number of studies, including #30, #31, #32, and #33. As

Adam Beeco of FERC commented, a shorter, safer portage plan is needed at the Bellows Falls Project. The portage at the Wilder Dam is nearly as bad, and an alternate route on the other side of the river has been suggested. The portage at the Vernon Dam also has issues. These portages should be addressed somewhere in these studies.

Study #31, Whitewater Boating Flow Assessment.

The mechanisms of controlled-flow whitewater evaluations at sites such as Sumner Falls and Bellows Falls are widely known and have been used by TransCanada on other rivers. We believe that the keys to successful evaluations include working together with NGOs to obtain the right mix of paddlers in the right mix of craft, having controlled flows that provide a good range of conditions, and using good evaluation survey forms with the boaters. Members of the AMC, New England FLOW, and American Whitewater have participated in several successful controlled-flow studies during FERC relicensings on other New England rivers for more than 20 years.. We look forward to working with TransCanada's consultants as they get closer to the study.

Sumner Falls has been used as a play spot by kayakers for years. The appropriate range of flows is known, and the surfing waves that form even have names. This should be a straight-forward project. Timing may be an issue, as well as achieving some of the higher flows that are greatly valued at the site.

Bellows Falls is a different situation because we know very little about this whitewater reach. We can scout it at various flows, but we won't really know until the boaters hit the water. We appreciate that opportunities have been built into the study for scouting and appraisal by expert boaters before the controlled-flow study begins. That should help us determine the appropriate size for evaluation flows. Even those predictions may need to be modified after the initial runs.

It is important that flows in the bypass reach be accurately measured. TransCanada does not have much experience in providing precisely controlled flows from its dam above the Bellows Falls bypass reach. Concerning the gates available to release water at the Bellows Falls bypass reach, TransCanada said (p. 226): "The minimum gate opening for these gates is 1 foot to prevent river debris from damaging the submerged seals or getting lodged and preventing the closure of the gate. Considering the overall 3-foot range of operation of the impoundment, a 1-foot opening discharges 3,000 to 3,300 cfs into the bypassed reach." We have no idea what a decent flow would be in the bypass reach. A flow of 3,000 cfs or higher might well be appropriate.

The flows provided for evaluation should be measured exactly, rather than being estimated. Any sloppiness in this area can create problems after the license is issued. We understand that sometimes it is difficult with large hydropower gates to exactly measure flows. Again, we look forward to working closely with the consultant to learn which flows can safely provide maximum opportunities for whitewater recreation.

In conversations at White River Junction with the consultants who will be running this study, we felt they had a good handle on the situation. One unresolved issue is what to do about the low-head fish barrier dam near the bottom of the bypass reach. The AMC favors removing the dam. TransCanada has refused requests to remove the dam prior to this study. The consultants say they had been studying the dam under different natural flow conditions and they believe it is runnable. We'll want to take a close look at it and the boaters in the test runs will make their own decisions about that.

Since TransCanada and other stakeholders have several legitimate issues with that low-head fish barrier dam, we proposed in White River Junction that a subgroup of these stakeholders look into positive benefits such as removal, ownership, modification, future uses, and so forth. In published comments after the meeting, TransCanada said, "There may be many considerations for the dam positive and negative relative to other resources and we feel we can assess flows without removal." But the creation of a subgroup was not addressed. Given the multiple benefits of dam removal, we consider this position particularly short-sighted. We recommend the creation of such a group that can work cooperatively with TransCanada to better understand the issues and the option of removal.

We look forward to reviewing the evaluation forms, and to doing the preliminary examinations and site visits that will be possible prior to conducting the controlled-flow study.

Study #33, Historical and Cultural Objects.

This study does not address our request to preserve photos and historical documents in possession of TransCanada related to the construction of the dams. These are historical materials in possession of the applicant that need to be inventoried, and plans devised for their preservation.

Note on a study not done. TransCanada has declined requests to do a contingent valuation study of whitewater in the Bellows Falls bypass reach.

Contingent valuation studies seek to put two competing social "goods" on an equal footing. They do this by assessing "value," that is, the value of an activity for society and what may be lost if the activity is prevented from occurring. Value is different from revenues, in the business sense. A tobacco company may make a lot of money, but that does not necessarily give it a value in society.

In contingent valuation studies at hydropower dams, we have one activity that can easily express itself in dollars—hydroelectric generation. Such generation comes from the public's river water run through turbines. Other activities may compete for that water and reduce company revenues. How are we to compare the value of a shad in the Connecticut River above any of the TransCanada dams? How can we value the recreation generated by putting river water back into the natural stream bed for whitewater recreation? How do we compare the scenic beauty of a natural river with the lost revenues when a bypass reach takes some water from the turbines? Comparing such activities as fish, recreation, and beauty with company revenues works against the fish, the boaters, and the public. Contingent valuation was a technique produced to compare those activities on an equal footing.

We don't do that anymore with fisheries or scenic values, but at one time it was done. Rather than dealing with dollar revenues, the term "value" was used. Contingent valuation places a value on different activities based on the social goods produced. A shad in the river has a social value. Recreation in the natural stream bed has a value. Beauty has a value. Flipping a switch and having the lights turn on has a social value. Contingent valuation studies are how these things are put in the same framework so they can be compared.

We understand that TransCanada may wish to avoid such comparisons. For one thing, the social value of hydropower is diminished when a company charges a profit to provide electricity.

We cannot force TransCanada to do a contingent valuation study, or FERC to order one, but this metric is clearly relevant in determining value. Lacking a study of comparative social values, we do not want to hear TransCanada arguing during the mitigation phase of relicensing that they cannot provide one thing or another because it would cost them too much money. That argument goes out the window along with the rejection of contingent valuation studies.

Conclusion

The Appalachian Mountain Club respectively requests that FERC accept these comments and direct the licensee to revise its proposed study plans to address the concerns raised. Thank you for considering these comments.

Respectfully submitted this 10th day of July, 2013,

____

Norman Sims
Appalachian Mountain Club
16 Linden Ave.
Greenfield, MA 01301

CITY MANAGER'S OFFICE
City of Lebanon, NH
51 North Park Street
Lebanon, NH 03766
(603) 448-4220

TO: Mr. John Ragonese, Project Manager, Transcanada
(via email to john_ragonese@transcanada.com)

Mr. Kenneth Hogan, FERC
(via email to kenneth.hogan@ferc.gov)

FROM: Mayor Georgia Tuttle and Members of the Lebanon, New Hampshire City Council

DATE: July 3, 2013

RE: Federal Energy Regulatory Commission (FERC) Process – Relicensing of Wilder Dam. City of Lebanon Support for Transcanada's Proposed Study Plan

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The City of Lebanon, New Hampshire, is proud to be a host community to the Wilder Dam. City residents and visitors benefit not only from the tax revenue generated by the dam, but also from the river-based recreational opportunities that the dam provides. The City nevertheless has concerns that the operations of the dam may have negative impacts, not only on the Connecticut River and its ecosystem, but on the entire Connecticut River watershed.

The City of Lebanon welcomes the opportunity to participate fully in the re-licensing process and to foster a relationship with Transcanada. Around May 15, 2013, in response to the call for study requests and comments on the Transcanada re-licensing Pre-Application Document (PAD), the City of Lebanon submitted a number of requests including incorporating the Lebanon Natural Resources Inventory (NRI) and documentation of the mist community at the base of the Wilder dam to the project library. Further the City was a co-signer on a request to study piping erosion and worked with NH DES to include channel morphology in the benthic habitats study. The City requested a review of conditions at the Wilder Dam picnic area and portage as well as the inclusion of all existing and potential recreational facilities in the proposed recreation facilities study—in particular, the Westboro Railyard, which sits just one-tenth of a mile south of the project area boundary and which the City believes has significant recreational, cultural and historical potential for West Lebanon and the Upper Valley.

City of Lebanon representatives were able to attend all of the six Proposed Study Plan (PSP) meetings during May and June of 2013 as well as participate in follow-up telephone conferences to further refine the studies and methodologies. The City looks forward to participating on the study sub-committees for Erosion, Terrestrial, Recreation & Aesthetics, and Cultural & Historical. We understand that the sub-committees will meet for one to two years depending upon the subject areas.

We appreciate that all of the requests made by the City, to date, have been or will be addressed within the Study Plan. The following acknowledgements were made during the PSP review process and further address the City's concerns:

- All recreation facilities along the River will be included in the Study Plan rather than just those within the defined project areas. The City's riverfront municipal conservation areas at Chambers, Cole, and Two Rivers will be included, as well as New Hampshire Fish and Game's Trues/Blood Brook cartop boat launch. Westboro and River Park, both potential recreation facilities, will likely come under the section of the study pertaining to future needs. Maintenance of existing facilities and inclusion of interpretive/educational materials at the Wilder Dam Picnic Area and portage trail will be included in the first phase of the Recreation & Aesthetics study, which includes obtaining information regarding the condition and use of existing recreation facilities and public viewing areas.

- There are a number of sensitive cultural and historical sites along the River. The City encourages the protection of information relative to preserving the integrity of these sites while noting that the City does have artifacts (mostly railroading) that could be of interest for display at some point.

- In 2012, Transcanada commissioned a Rare, Threatened and Endangered Plant Species Study conducted in 2012 by Normandeau Associates. A "public" copy of this report, which does not include location of sensitive sites, was only recently made available on the FERC website for review.

- It was noted that a number rare/unusual habitats, similar to the mist community, had been identified already by Normandeau, the project consultants. Comments from the City's NRI Consultant, Dr. Rick Van de Poll, were included in the transcript and noted by the Normandeau's consultant Sarah Allen.

- The City supports the recommendation from NHFG fisheries biologist Gabe Gries to include Mascoma River and the White River among the 6 tributaries to be selected for the channel morphology and benthic habitats in addition to 12 locations on the mainstem.

- The City strongly recommends that the Hydraulic Modeling study place additional pressure-transducers (data-logging devices) along the Lebanon portion of the mainstem, particularly downstream of the White River. Suggested locations included the Chambers/Cole reach, the Westboro reach, the White and Mascoma confluences, and the Rt. 12A reach (below I-89).

- The White and Mascoma rivers will be included among the tributaries in the Operations Modeling study and the Mascoma River is among the 10 major tributaries that will be monitored at their respective confluences with the mainstem under the Water Quality study.

- The City will provide our available digitized aerial and historic maps in support of the Erosion and other studies.

- The City is reviewing areas of concern along the City's stretch of the river for potential transect locations for the Riverbank Transect Study and the Riverbank Erosion Study. We understand that the same transects will be used in both studies and that additional transects could be added.

The Lebanon City Council supports the revised Proposed Study Plan (PSP). We look forward to working with Transcanada and the Federal Energy Regulatory Commission to address issues of concern and to foster an ongoing, mutually beneficial relationship with Transcanada.

For the Lebanon City Council:

Georgia A. Tuttle, Mayor, Ward 1
Stephen M. Wood, Assistant Mayor, At Large
Bruce Bronner, Councilor, Ward 2
Nicole S. Cormen, Councilor, At Large
Carol W. Dustin, Councilor, Ward 3
Erling Heistad, Councilor, At Large
Karen Liot Hill, Councilor, Ward 3
Suzanne M. Prentiss, Councilor, Ward 1
Heather C. Vogel, Councilor, Ward 2

Georgia A. Tuttle (PM)
Georgia A. Tuttle
Mayor, City of Lebanon

VIA ELECTRONIC FILING

Kimberly D. Bose, Secretary

Federal Energy Regulatory Commission

888 First Street, N.E. Rom 1-A

Washington, D.C. 20426

Re: Comments on TransCanada Hydro Northeast Inc.'s Proposed Study Plans

Project Nos. 1892-026, 1855-045 and 1904-073

July 15, 2013

Dear Secretary Bose,

The Connecticut River Joint Commissions is writing, pursuant to 18 CFR 5.12, in response to TransCanada's Proposed Study Plans (PSP), filed on April 15, 2013 concerning the hydroelectric projects referenced above. These comments are submitted on behalf of the Connecticut River Joint Commissions, Inc. (CRJC), a public not-for profit organization incorporated in the State of New Hampshire and comprised of two entities, the New Hampshire Connecticut River Valley Resource Commission (CRVRC) and the Vermont Connecticut River Watershed Advisory Commission (CRWAC).

VT Connecticut River Watershed Advisory Commission • NH Connecticut River Valley Resource Commission
10 Water Street • Suite 225 • Lebanon, NH 03766 • 603-727-9484 • www.crjc.org

New Hampshire’s Connecticut River Valley Resource Commission (CRVRC) was created by the New Hampshire Legislature in 1987. The purpose of the CRVRC is to cooperate with the state of Vermont in protecting and preserving the visual, ecological and agricultural integrity of the Connecticut River Valley while planning for and guiding the development of the recreational, tourist, commercial and residential uses of the Connecticut River Valley. Vermont’s Connecticut River Watershed Advisory Commission (CRWAC) was created in 1988. The CRWAC was established to develop ways to cooperate, and to initiate and encourage interstate cooperation and coordination with the state of New Hampshire.

The Connecticut River Joint Commissions has facilitated coordination of plans, programs, and projects on behalf of the two commissions since 1989. The Connecticut River Joint Commissions appreciates the level of effort put forth by the applicant, TransCanada, in collaborating with stakeholders on the Proposed Study Plans.

General Comments on the Proposed Study Plans

The following comments relate to many or all of the plans.

- The role of climate change in influencing the impact of project operations on the ecology of the Connecticut River system should be addressed. While Tropical Storm Irene in 2012 appears to have resulted in one of the worst flooding situations in many years, it may not be the most extreme event that will occur in the future. Due to concerns about climate change, model runs should incorporate scenarios of more frequent and intense storm events as well as future prolonged periods of drought to examine worse case conditions.
- Study results should be compiled as a comprehensive electronic topographic base map that extends laterally to at least the extent of the 500-year flood and include bathymetric mapping of instream features. It should show the locations of inventoried species as well as critical habitats. This base map should (1) show 1-foot contours and the extent of flooding during yearly, 100-year and 500-year storm events, (2) be scalable and (3) be available in the public domain.

Request for an Economic Impact Study Plan

The economic impact of project operations has not been addressed in any of the study plans currently proposed. The economic impact of the projects operations, both positive and negative, affects many interests and relates to many resources. In order to assess the cost-benefit of various operational models, a comprehensive and objective assessment of these impacts, including on the local communities, must be made.

CRJC is entrusted by the two states with planning for and guiding the development of commercial uses of the Connecticut River Valley. Operation of the hydroelectric dams is the paramount commercial use in the bi-state river region, and we believe that all parties affected by the projects will benefit from using a cost-benefits analysis in assessing cumulative impacts.

Economic impact assessments should include both the cost and benefits of project operations to landowners, private businesses, municipalities, states and TransCanada's shareholders, including the following:

1. Outdoor recreation, including fishing, boating and swimming activities. Impoundments create opportunities for recreation. Negative impacts could result from fluctuating water levels, turbidity from erosion and impacts of dam operations on water quality.

2. Positive and negative municipal impacts include payment of property taxes, effects on property valuations including flowage easements, effects on infrastructure such as New Hampshire Route 12, and changes in tax assessments as a result of judicial appeals should be included. Benefits could accrue from a lowering of electric rates in riverfront towns.
3. Environmental impacts include benefits from green energy production and creation of habitat. Costs may be associated with effects of erosion, toxin accumulation in fish and sediments, turbidity and erratic flows.
4. Property and business owner costs include recovering from flood damage, loss of property value and loss of developable land.

Related studies on the economic impact of outdoor recreation in the two states (cited in *CRJC, 2009:6-8*) and the economic impact of water quality (*Nordstrom, 2007*) have been conducted. But a comprehensive cost-benefit analysis such as we recommend, has not been done. Using available data, we believe it can be undertaken by an economic consultant for a relatively moderate cost. We recommend that the applicant work with the states, regional planning commissions, affected businesses and other interests to conduct an evaluation of the economic impact of project operations.

Comments on Specific Study Plans

For ease of reference, we follow the same study plan number and title as used by the applicant.

1. **Study Plan #4, Hydraulic Modeling Study:** This study plan, as currently proposed, does not assess the effect of climate change. The applicant's study approach entirely relies on historical stream gage data to extrapolate future flows.

Discussion:
It is well documented that in the decades since the construction of the project dams there have been significant changes in the frequency and intensity of precipitation events. Specifically, between 1958 and 2010 the Northeast saw a 74% increase in the amount of precipitation falling in very heavy events (*NCADAC, 2013*). The applicant should develop an analytical tool that has the ability to evaluate the potential effects of more severe storm events and prolonged periods of drought. The goal for doing so is to provide more realistic and accurate projections of future flow conditions. These projections are not possible if only historic gage data are used.

To date, the applicant does not propose to address climate change as it relates to project operations because it claims "such a study would not necessarily inform potential mitigation measures (FERC study criteria 4) and would be cost prohibitive (FERC study criteria 7)." (*TransCanada, 2013b:7*).

It is unclear if the applicant's proposed hydraulic model can determine the effect of anticipated future meteorological trends. This approach is insufficient to inform potential mitigation measures for project effects related to climate conditions over the next forty years. Practicable operational alternatives can be explored and evaluated only if there is a hydrologic model that can be used throughout a full range of flows, including extreme high and low flows due to climate change, in order to avoid and reduce projected adverse effects.

Moreover, the cost to develop a hydraulic model that incorporates projections of future stormwater flows can be significantly reduced if the applicant cooperates with regional partners in its development. The reliability of flow projections over the term of the requested licenses has an unequivocal nexus to assessing the effect of the projects operations.

Comprehensive River Plan:
The *Connecticut River Water Management Plan Riverwide Overview*, developed and published by the Connecticut River Joint Commissions in 2008 includes several pages on the subject of "climate change." In it are examples of recent intense rain episodes with resulting erosion and sedimentation, and a discussion of droughts and how they increase demands for river water (*CRJC, 2008:29-30*).

Recommendation:
As an alternative to a study of climate change per se and since the proposed hydraulic model will be an important element used in fully evaluating many of the other environmental, historic and habitat impact studies, the model should be robust enough to evaluate the effects of variable flows including higher and or lower flows anticipated due to generally accepted precipitation forecasts associated with climate change. The model should have the capacity to incorporate and predict impact on river resources at the flood flow levels already part of the FERC required safety review of the dams.

2. **Study Plan #4, Hydraulic Modeling Study and Study Plan #5, Operations Modeling Study:** The proposed studies, as currently presented, will not be capable of assessing the effect of the existing dams and their operations on a variety of floodplain resources.

Discussion:

Do the dams contribute to seasonal flooding or increase the elevation of the 100-year and 500-year storms on adjacent lands? Do project operations contribute to reaches of the river incising, cutting them off from their floodplains? How do project operations affect flooding of low-lying properties during flood events?

In response to a request from the Vermont Agency of Natural Resources that the applicant identify the extent of development within the floodplain of the lower Connecticut River, the applicant stated that the request was aimed at mitigation and lacks a nexus to the three projects and thus would not meet FERC's study criteria 5. Further, the applicant stated that this study request would not inform measures that could be considered for a new license, and thus does not meet FERC study criteria 6. (*TransCanada, 2013b:52*)

In the applicant's denial of a request from The Nature Conservancy (TNC) to survey habitats within the 100-year floodplain, the applicant states that such a survey "could result in extensive mapping of terrestrial habitats far from the river. This will not contribute significantly to the information needed to assess the areas influenced by project activities, and hence is not included in this study." (*TransCanada, 2013c:5*).

Despite the applicant's assertion that natural and human resources in the floodplain are not germane to project operations and therefore should not be inventoried, the applicant has agreed to assess current project effects on floodplain forests (*Study Plan #27).* The selection of only one resource ignores the fact that other floodplain land uses and resources have compelling community, ecological, and economic values that warrant at least as much consideration as floodplain forests.

Additionally, the applicant has primarily limited the project study area to project lands and 200 feet of upland buffer, but this determination ignores significant resources on private lands and the full lateral extent of potential impacts from project operations. For example, the Town of Westminster, Vermont attributes annual spring flooding "in the low lying areas adjacent to the Connecticut River, particularly on Route 5 where the businesses Allen Brothers and Patriot Motors are located" to the operations of the Bellows Falls dam (*Town of Westminster, VT, 2013:11*). This issue has not been addressed in any of the study plans.

The Connecticut River Valley has experienced several 500-year storms in recent history, and more can be expected during the term of the proposed license application *(e.g., see CRJ C, 2008:29*). The lateral extent of studies that the applicant proposes is too limited in geographic scope to enable an adequate assessment of project impacts. The goal of expanding the study area is to overcome limitations inherent in (1) defining the study area to an arbitrary 200 feet from the river's edge and project lands and (2) selecting only one resource, among many, for specific study. The study objective instead should be to document significant resources, including roads, buildings, farmland and important habitats in the floodplain that may be affected by dam operations over the term of the proposed licenses.

Recommendation:

The proposed hydraulic and operations modeling studies should be capable of assessing the effect of project operations on a greater variety of significant public interests in the geographic area that would be affected by a 500-year storm. This requires delineating the lateral extent of the 500-year floodplain so that resources in this area can be inventoried.

We encourage the applicant to partner with other entities to (1) develop a more robust hydraulic model (2) clearly define the elevations of the annual, 100-year and 500-year flood events, and (3) share the cost in modifying the study plan.

3. **Study Plan #5 Operations Modeling Study and Study Plan #6, Water Quality Monitoring:** The studies do not address the accumulation of toxins in the river and their effects on fisheries and public health.

Discussion:
No study of the effect of project operations on toxins was requested by FERC or the public, and the applicant does not propose to do one. Consequently, the effect of project operations on the distribution and biological concentration of toxins, such as mercury and dioxin, is not proposed to be assessed. Mercury is a neurotoxin that threatens public and environmental health. It has been shown that in fluctuating impoundments, such as those behind the dams, mercury moves up through the food chain in the more dangerous methylated form (*Evers, 2007*). As a result, dam operations may have exacerbated the concentration of mercury in fish in the impoundments.

A study conducted by the United States Environmental Protection Agency and the four Connecticut River states, at the request of CRJC, found that Connecticut River fish tissue showed bioaccumulation of mercury and dioxins, sometimes to high levels, in the aquatic food chain (*U.S. EPA, 2006*). The CRJC recognizes that the applicant may not want the acceptance of this study plan modification to imply responsibility for existing mercury in the river as it is widely acknowledged that the majority of the mercury in the project watershed is the result of airborne emissions. Nevertheless, the projects' fluctuating reservoirs may continue to contribute to enhanced bioaccumulation of mercury in fish in the river. Therefore, more study is needed in the specific reaches of the river that are subject to the pending FERC license application to assess the impact of the reservoirs on this process as it is a threat to human health. Currently, the NH Department of Environmental Services has a fish consumption advisory in effect for the Connecticut River because of documented high mercury levels.

Comprehensive River Plan

The Connecticut River Recreation Management Plan prepared and published by the Connecticut River Joint Commissions in 2009 includes top recommendations from each of the five local river subcommittees. The Upper Valley, Mount Ascutney, and Wantastiquet subcommittees, which cover the river reaches affected by relicensing, each had a strong recommendation to "reduce mercury contamination in the Connecticut River system" (*CRJ C*, *2009:68*).

Recommendation:

We recommend that Water Quality Study Plan #6 be amended to sample sediments and fish tissue for mercury and dioxin within the project area. The goal of this sampling will be to identify mercury levels in the three reservoirs, and inform possible mitigation measures.

The cost for this study modification is modest in relation to the impact mercury has on human health.

4. **Study Plan #6, Water Quality Monitoring and Study Plan #27, Terrestrial Studies:** The updated studies do not specify parameters or methodologies that can be used to determine if wetlands are being degraded by project operations.

Discussion:

Wetlands as well as surface waters are "waters of the United States" and both are subject to provisions of Section 401 of the Clean Water Act (see *Kusler, 2012*). The applicant proposes to collect data to determine if the projects are meeting state water quality standards; however, it does not offer a plan to establish baseline wetland conditions in order to critically assess project effects on wetlands.

Study Plan #6 is designed to determine the operational effects of the projects on surface water quality parameters (e. g., dissolved oxygen and temperature). However, these parameters are not as useful in assessing the quality of many wetlands, which only need to be saturated near the surface for short periods during the growing season. Thus, we suggest that the applicant collect data on species-richness (species diversity and abundance) at permanent wetland reference sites to determine if project operations affect wetland health. Changes in species-richness are known to track changes in water quality.

The applicant's July 3rd updated Terrestrial Study Plan #27 proposes to provide detailed mapping and characterization of wetlands; however, we suggest that reference wetland sites outside of the zone of influence of the project be established and delineated according to the methodologies currently required by the United States Army Corps of Engineers. This will enable changes in species-richness in wetlands affected by dam operations to be compared with changes in species-richness at reference sites that are not affected by project operations. In essence, the sites outside of the influence of the dams act as control sites.

A crucial component of a biological assessment program is the careful selection of reference sites. Reference sites are wetlands of the same class that define the best possible condition for that class. (*U.S. EPA, 2002*). The applicant states that "data for reference wetlands will not be collected, as proposed in an agency study request. On a large system such as the Connecticut River it is unrealistic for several reasons: few if any reaches of the river are not affected by water management; the river changes character rapidly north and south of the project areas; and lastly, the natural variability of any potential reference habitats would require a very large data set for effective comparisons to project habitats, of limited value and at significant expense." *(TransCanada, 2013c:4).*

Nevertheless, we believe the use of reference sections is a cost effective way to ensure wetlands are not degraded by project operation and suggest the applicant consider amending the Terrestrial Study #27 to: (1) establish permanent reference sites (within and outside the zone of influence of the project) in various wetland classes (e.g., palustrine forested, scrub-shrub and emergent), (2) inventory species-richness at each of the sites and (3) monitor changes in species-richness over time at each of the sites to assess the effect of project operations.

Statutory Authority:

Section 401 of the Clean Water Act. "A State's authority under Section 401 includes consideration of a broad range of chemical, physical, and biological impacts. The State's responsibility includes acting upon the recognition that wetlands are critical components of healthy, functioning aquatic systems." (*U.S. EPA, 1989:6*).

Recommendation:

Amend the Water Quality Study Plan #6 to acknowledge that wetlands need to be monitored to ensure they are not degraded. Amend Terrestrial Study Plan #27 to identify the locations of reference sites in high quality wetlands, within and outside of the zone of influence of the project, which can be delineated and monitored for changes in species richness to assess whether wetlands are being degraded by project operations.

The cost to include this recommendation in the study plan should be minimal.

5. **Study Plan #9, Instream Flow:** This study plan should be modified to include a determination of the flow requirements of all significant uses for which the river was designated into the New Hampshire Rivers Management and Protection Program, rather than just aquatic life.

Discussion:

The Connecticut River has been incorporated by the legislature into the New Hampshire Rivers Management and Protection Program (NH RSA: 483) and the statute stipulates that instream flows be protected on every statutorily designated river. The Souhegan and Lamprey Rivers have had necessary flows established through a Pilot Study that would inform models for the Connecticut and other rivers.

We believe it is the responsibility of applicants seeking new permits or renewal of licenses on the Connecticut River to respect New Hampshire statute in the course of their relicensing applications. They should document the effect of their proposed operations on protected uses for the Connecticut River (see RSA: 483:15 VIII and NH RSA 483:7a), and especially on those uses that qualified the river for designation into the Rivers Management and Protection Program (RSA 483:6).

While the current dam licenses require a continuous minimum flow from the powerhouses of 675, 1,083, and 1,250 cfs, for the Wilder, Bellows Falls, and Vernon Projects, respectively, under the applicant's Study Plan #9 only the extent to which these flows protect aquatic life will be addressed. However, New Hampshire law requires the New Hampshire Connecticut River Valley Resource Commission, as the local river management advisory committee (NH RSA 483:8a IV), to "consider and comment on any federal, state, or local governmental plans to approve, license, fund or construct facilities that would alter the resource values and characteristics for which the river or segment is designated." (483:8-a III (b)). Under RSA 483: 9-c, these resource values and characteristics include "water for instream public uses and …. recreational, fisheries, wildlife, environmental, hydropower, cultural, historical, archaeological, scientific, ecological, aesthetic, community significance, agricultural, public water supply, and the resources for which the river or segment is designated…." The list of protected instream public uses also include "navigation; storage; conservation; the protection of water quality and public health; pollution abatement; and hydroelectric energy production." (RSA 483:4 XI). These, then, are the resources which should be initially addressed in Study Plan # 9.

Not all will undergo full study. Every State Protected River has a unique set of uses that are determined to be significantly affected by flows. For example, on the Lamprey, wastewater dilution was not found to be "flow dependent" because of the nature of its only wastewater disposal system. While on the Connecticut, the ability of the river to dilute effluent and other sources of pollution may be of concern. Only those uses found, in consultation with all of the stakeholders, to be significant and flow dependent would be subject to further analysis of their flow requirements.

The assessment of adequate minimum and maximum flows should include flows under varying operational and climactic conditions, including volume, duration, predictability and timing of flows. In Study Plan # 9, as proposed, only current and historic flows from dam operations are to be considered when evaluating the adequacy of flows. CRJC believes that in order for operational models to assure adequate instream flows, this study must also include projected future flows.

Comprehensive River Plan:

The *Connecticut River Water Resources Management Plan Riverwide Overview* prepared and published by CRJC in 2008 states "CRJC should identify Instream Protected Uses, Outstanding Characteristics and Resources listed in RSA 483 – for the Connecticut River, based on consultations with organizations, agencies, and communities, as well as discussions in the local river subcommittees." (*CRJC, 2008:20*).

Recommendation:

CRJC recommends that the applicant initially consult with organizations, natural resource agencies, communities and CRJC's local river subcommittees to consider all of the Instream Protected Uses, Outstanding Characteristics and Resources **(**IPUOCRs**)** listed in New Hampshire RSA 483 for which the Connecticut River was designated, in order to determine which are significant and flow dependent. This could be done using the protocols established in the Lamprey Pilot program (NHDES, 2006). Then, a determination should be made of which of these IPUOCRs have not been addressed by the applicant in other studies and warrant a full analysis of their flow requirements. These flow requirements should then be incorporated into the operations model.

Costs of this expanded study will be reduced considerably because much of the necessary data either will be generated in the course of other studies by the applicant, or are available from existing sources, most notably the Lamprey River and Souhegan River Pilot studies.

6. **Study Plans #'s 1, 2 and 3, Riverbank Erosion Studies:** These studies, as proposed, will describe erosion at diverse locations above and below the three dams but they may be insufficient to determine what proportion of that erosion is directly attributable to dam operations.

Discussion:

Studies to determine how the applicant's operations affect the rate of erosion should be based on an analysis of: (1) existing field conditions to identify all areas of erosion within the relicensing limits to interpret their causes, (2) historical surveys that show the locations of the banks prior to and after installation of the dams and (3) detailed geotechnical analyses to determine the affect of water level fluctuations on slope stability.

In the updated Study Plans the applicant has agreed to conduct a more intensive search for historical surveys but has not offered to conduct any geotechnical analyses to determine slope stability. Moreover, the number of erosion study sites proposed in the study plan and the short time frame over which these sites will be observed are unlikely to prove, with any degree of certainty, how the applicant's operations affect slope stability.

Bank erosion has significant impacts on many of the factors related to the relicensing of the Vernon, Bellows Falls and Wilder dams which include but not limited to: loss of agricultural land, water quality, aquatic habitat, endangered species, fish spawning, aesthetics, cultural and historic resources, possible impacts to brown field sites, etc. It is also accepted that vegetative riparian buffers are extremely important in maintaining water quality. Embankment erosion caused by project operations threatens these buffers.

There are substantial areas of significant erosion within the impoundments of the Vernon, Bellows Falls and Wilder dams as well as in the 'free flowing' reaches below the dams. With the extensive bank erosion in the Bellows Falls impoundment, on both the New Hampshire and Vermont sides of the river, the two proposed erosion study sites are simply inadequate to determine the impact of project operations on embankment erosion in this reach. This is a reach with a number of important resources that are being affected by erosion. As an example, in the reach from Charlestown to Walpole alone, erosion has necessitated the relocation of Route 12 and the railway at a cost of 20 million dollars.

Comprehensive River Plan:
The *Connecticut River Water Resources Management Plan Riverwide Overview,* developed and published by CRJC in 2008 identifies erosion as a significant issue, it states "[r]iverbank erosion is one of the most prevalent and misunderstood problems on the Connecticut River…." (*CRJC, 2008:11*).

Recommendation:

Expand the number of erosion study sites, particularly, in the Bellows Falls and Vernon impoundments to ensure a more complete range of erosion conditions are evaluated. Include at least five additional study sites in the Bellows Falls and Vernon impoundments. These studies should also be undertaken during high, low and transitioning water levels in order to more effectively evaluate the contribution of fluctuating water levels on erosion. Finally, in order to better assess the effect of project operations, we recommend a geotechnical slope stability analysis be conducted at each of the proposed study sites.

References

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Closing Remarks

The Connecticut River is a public resource. Federal and state laws have changed significantly since 1950 when the Wilder Dam received its federal license to generate power (Bellows Falls and Vernon Dams were licensed much earlier). More is known in 2013 about recreational, municipal, and other users of the river and about various species dependent upon river water and flows. CRJC believes that these recommendations are essential in order to bring the most robust science, analysis, and public participation to the challenge of a long-term license renewal for dams on the Connecticut River. CRJC strongly encourages FERC to require that the applicant incorporate the recommended changes outlined herein to the Proposed Study Plans. Once issued, the FERC license will remain in effect for a period of 30 to 50 years. Therefore, decisions regarding relicensing must be based upon an objective evaluation of past impacts caused by the projects and a thorough analysis of impacts expected to occur long into the future. The CRJC appreciates the thorough approach of FERC in assessing the many potential impacts to the environment from the applicant's license renewal application for these projects. We hope the magnitude of these impacts and the complex ecological interactions that will occur during the decades of project life will be appropriately investigated for the continued functioning of our shared public resource, the Connecticut River Watershed.

If you have any questions regarding the contents of this PSP comment letter, please feel free to contact either of us at via e-mail at Rebecca Brown 2sugarhillmutts@gmail.com and Brendan Whittaker gferbwick@gmail.com.

Sincerely,

____

Rebecca Brown

Chair, New Hampshire Connecticut River Valley Resource Commission

Signature

Brendan Whittaker

Chair, Vermont Connecticut River Watershed Advisory Commission

CONNECTICUT RIVER WATERSHED COUNCIL

The River Connects Us

Upper Valley: P.O. Box 206, Saxtons River, VT 05154

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E., Room 1A
Washington, DC 20426

July 15, 2013

RE: Review of the Draft Proposed Study Plans for FERC project numbers P-1904 (Vernon), P-1855 (Bellows Falls), P-1892 (Wilder)

Dear Secretary Bose:

The Connecticut River Watershed Council, Inc. (CRWC) is a nonprofit membership group established in 1952 to advocate for the protection, restoration, and sustainable use of the Connecticut River throughout its four-state watershed.

The interests and goals represented by CRWC include: improving water quality; enhancing habitat for fish and other aquatic biota; safeguarding and improving wildlife habitat; protecting threatened and endangered species; protecting wetlands; preserving undeveloped shore lands; enhancing public recreation and promoting recreation safety; protecting aesthetic values; protecting archeological, cultural, and historical resources; fostering sustainable economic development, energy production, and preserving the local tax base along the Connecticut River and its tributaries.

We appreciate the opportunity to submit our comments on the revised draft plans for the proposed projects P-1904 (Vernon), P-1855 (Bellows Falls), P-1892 (Wilder).

CRWC General Comments on Issues that Flow through all the Studies

Throughout the studies, each of the Deliverables sections say: "Results and conclusions will be reported in either the PLP or the draft license applications for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application."

- **Recommendation:** The stakeholders in this process should have more time to review the final study conclusions prior to them being included in either the PLP or the draft final application, especially the NGOs without consultant assistance.

In numerous studies, the definition of the point where the TC study responsibility ends and the 1st Light responsibility begins has not been resolved to the satisfaction of CRWC. In several of the studies, the language suggests that the study will end at the face of the Vernon Dam leaving a reach of the river below the Vernon Dam out in the cold. This lack of definition creates a ‘no man’s land’ in flow, fish assemblage, erosion, floodplain, riparian, habitat and recreation studies as well as in the selection of econode locations.

- **Recommendation:** All study plans should clearly identify an agreed upon location where one applicant’s responsibility ends and the other’s starts so there will be no reach of the river that is not covered by these studies.

Throughout the studies and in the conversations at the working group meetings TC referred to the study work as being “baseline” studies. Their assumption seemed to be that the way the river is now and the dams operate now would be how the river will be in the future with operations as they are right now. CRWC disputes that assumption. This FERC relicensing process as we understand it holds TC to a higher standard than business as usual. If this process discovers changes in operations, flow regime, seasonal operation standards or a way to improve river recreation access then those improved situations should become the new baseline. CRWC has no specific recommendation that covers this observation but want FERC and the applicant to understand that CRWC and our members want a better healthier more user accessible river when this licensing process concludes in 2018.

CRWC Comments on Specific Studies

Study 1 Historic River Bank Position and Erosion

CRWC has no further comment as the updated draft of Study plan 1 incorporates the CRWC suggestion that along with other research that there will be direct landowner outreach.

Study 2 River Bank Transect

The problem of erosion is not just a matter of high flows and ice out scour. There is legitimate concern that daily reservoir level fluctuation causes piping of water in and out of a saturated bank, piping that would be an important contributor to the erosion problems landowners are experiencing in the impoundment areas.

Ongoing monitoring would capture data on such effects. The draft plan now says that TC will meet with the working group to discuss increasing monitoring. The plan should say that the ongoing bi-weekly site review will continue to take place throughout the study period and that TC will meet with the working group to see if there is any reason to stop the ongoing monitoring.

- **Recommendation:** The study plan should include the 18 ongoing monitoring sites requested by NHDES, VANR and NHF&G.

Study 3 River Bank Erosion

CRWC has no further comments as the updated study plan incorporates the suggestions offered by CRWC and other working group members.

Study 4 Hydraulic Model
Since the proposed hydrologic model will be an important element used in evaluating many of the other environmental, historic and habitat impact studies, the model should be robust enough to evaluate the effects of numerous variable flows including higher and or lower flows anticipated due to the effects of climate change.

The value of a robust model is important for understanding the future health of the river. CRWC understands that the dams cannot store floodwaters but with a model that predicts exceptional water levels caused by climate change be they wet or dry, it should be able to predict impacts over time on river resources. By building in the capacity to predict higher and lower flows than have occurred historically, TC can produce a value added tool for the benefit of the river. The model should be able to predict flows at the flood flow levels already part of the FERC required safety review of the dams.

- **Recommendation:** The hydraulic model should have the capacity that when correlated with the other studies predict impact on river resources due to exceptional flow caused by climate change. The model should be available to planning, river resource and emergency organizations in the watershed.

Study 5 Operations
CRWC has no further comments as the updated study plan incorporates the suggestions offered by CRWC and other working group members.

Study 6 Water Quality Monitoring
CRWC called for temperature monitoring from April to November in order to gain a better understanding of potential project effects, especially coupled with the water temperature increases due to Vermont Yankee. We feel that was an appropriate change to the study plan and recommend that FERC hold with those dates in their approved plan. This approach will provide temperature data that would be useful in subsequent studies that depend on water temperature such as downstream migration of juvenile American shad.

TC has made it clear they want nothing to do with the Entergy VY thermal plume. CRWC knows TC is not responsible for the plume or its effects, other than the influence of the impoundment on mixing. Nevertheless, there is only one river and the stakeholders should have information about the plume and its extent to establish accurately where it occurs.

- **Recommendation:** That TC place more than one temperature logger transect above the Vermont Yankee discharge and more than one between the Entergy discharge and the Vernon dam in order to better differentiate between potential impacts of Vermont Yankee and TransCanada on water temperature.

Study 7 Aquatic Habitat Mapping

There is a value to having this information about the “as is” situation within the riverine and reservoir reaches affected by the project. Unfortunately, there is no aspect of this or any other study planned to learn how the aquatic habitat has changed over time since the installation of the dams. Neither this nor any other study will capture this historic river value. Clearly, we cannot recreate the past but TC should conduct a literature search for information about the river before TC or its various predecessors built the dams. Any literature information gathered should become part of the published results of this study and offer a comparison between what was and what is. That comparison is one element of a true study of the status of aquatic habitat

- **Recommendation:** TC should conduct a literature search about river habitat conditions over time. This will allow a some level of comparison of the habitat as it exists today to the habitat conditions prior to the construction of the dams.

Study 8 Channel Morphology and Benthic Habitats

CRWC has the same comments as we made regarding Study 7. There is a value to having this information about the “as is” situation within the riverine and reservoir reaches affected by the project. An unknown is how the channel morphology and benthic habitat has changed over time since the installation of the dams. No study accounts for this river history.

- **Recommendation:** That TC conducts as part of the desktop verification work a literature search about river conditions over time. This will allow some level of a comparison of the channel morphology and benthic habitat as it exists today to the conditions prior to the construction of the dams. The study should present any information and offer a comparison between what was and what is. That comparison is one element of a true study of the river morphology and the creation and or destruction of benthic habitat.

Study 9 Instream Flow

CRWC has no further comments as the updated study plan incorporates the suggestions offered by CRWC and other working group members.

Study 10 Fish Assemblage

Although this version of the draft plan incorporates many of the suggestions provided by the fisheries agencies there are some additional comments submitted by VFW and NHFG that have not yet been incorporated in this draft, specifically the use of various types of gear not just electro fishing and gill netting. Both state agencies call for some portion of the hours of sampling to take place at night.

- **Recommendation:** CRWC supports the call by VFW, NHFG that sampling should take place during day and night time hours and that TC should conduct the sampling with gear as suggested by VFW.

Studies 11 – 18 – 19 – 20 Eel survey and Up and Downstream Eel Passage and Timing
These studies are all related to one species, a species that is hard to capture in the wild by using the techniques suggested by TC but they are the best available. One note is that there is a higher level of damage to eels captured with electro shocking than there are with eel pots. (James B. Reynolds and F. Michael Holliman, 2003)

- **Recommendation: If** the sampling numbers are sufficient to generate useful data using eel pots, then the fieldwork should rely on eel pots as much as possible to reduce harm to eels during sampling.

TC plans to survey only waters affected by project operations for eels and that is problematic given the difficult nature of capturing eels. There are points on tributary waters where up migrating eels will concentrate due to the stream formation or manmade infrastructure. Although these locations are not immediately in the project affected waters they will yield useful data as to the presence of eels throughout the entire reach of river affected by the three projects. Examples of these locations are the falls at Drewsville, NH on the Cold River; the face of the dam in Springfield, VT in the Black River; below the falls at Brockway Mills, VT on the Williams River and at the base of Twin Falls on the Saxtons River. Each is only a short distance from the main river and because each has a defined search area the relative additional effort should not be prohibitive.

- **Recommendation:** In order to get the fullest picture of the presence of American eels in the CT River watershed, eel sampling should take place at several migration barrier locations on the tributaries even though they are outside the immediate influence of the project operations.

Study 12 Tessellated Darter Survey
CRWC has no further comments as the updated study plan incorporates the suggestions offered by CRWC and other working group members.

Study 13 Tributary and Backwater Fish Access and Habitats
CRWC has no further comments as the updated study plan incorporates the suggestions offered by CRWC and other working group members.

Study 14 - 15 Resident Fish Spawning in Impoundments
There are no provisions in the studies that will assess the effects of sediment deposition on the redds of spawning fish and other aquatic species. This sediment deposition would not be determined as part of the embeddedness characterization. Based on personal experience, the buildup of sediment behind the dams is seasonal based of the river flows. Sediment settles out when water velocity slows down in the late spring. Once water levels drop in the spring, the deposition of sediment accelerates and it would be important to know if that occurs in spawning depth water.

- **Recommendation:** The fish spawning study should record where newly deposited sediment has covered suitable spawning habitat. The study should make an assessment of whether the deposition is from project operations or if other flows were a factor.

Study 16 Sea Lamprey Spawning Assessment
In the 30 years that I have fished the wadeable sections of the main river, I have never seen sea lamprey spawn in the main river. I have seen them in the wadeable tributaries all the way from the point where the tributary is just beyond the reservoir effects of the dam to points well up stream of the main river until there is a natural or manmade barrier to further up migration.

- **Recommendation:** TC plans to chase radio tagged lamprey even if they head up tributaries so documenting other untagged lamprey identified during the same on the ground excursion could take place while looking for the tagged fish. This of course could not apply in cases where the tributary work is done by plane but some effort to identify as many spawning lamprey even if they are in tributaries would be useful information. The same barrier points listed in the American eel studies would be useful survey sites.

Study 17 Upstream Passage of Riverine Fish Species
CRWC has no further comments as the updated study plan incorporates the suggestions offered by CRWC and other working group members.

Study 21 - 22 American Shad Telemetry and Downstream Migration of Juvenile Shad
Since TC has rejected outright the CRWC call for a shad population model, it is vital that these two studies be as far reaching as possible. Possible limiting factors on the full restoration of the American shad in the upper reach of the Connecticut River include passage efficiencies at downriver dams along with one other critical unanswered question, the effect of the Entergy VY plant thermal discharge on the downstream migration of adult and juvenile shad. Although the issue has been debated and litigated over the years there still has been no definitive analysis of the possible effects of the plume on successful migration of shad.

TC struck any mention of the VY discharge from this version of the draft plan. CRWC knows that TC is not responsible for the VY discharge but feels that studying the effects of the discharge on migrating shad could indicate that changes might be appropriate as to where the downstream fish tube is located in the forebay area, i.e. further to the east; outside the heated water plume could be of value to increasing spawning and juvenile success.

- **Recommendation:** That TC should study all of the impediments to successful shad spawning and downstream migration including evaluation of the effect of the heated water discharge plume from Vermont Yankee. The study should determine if the plume affects the choice of juvenile shad's downstream passage route, migrant residence time in Vernon pool attributable to the thermal plume and any effects on the timing of shad migration. The study should recommend if the change in the location of the fish passage tube would improve fish passage.

- **Recommendation:** That TC place more than one temperature logger transect above the Vermont Yankee discharge and more than one between the Entergy discharge and the Vernon dam in order to better differentiate between potential impacts of Vermont Yankee and TransCanada on water temperature. (Same as recommendation under Study 6)

- **Recommendation:** That TC develops a metric for shad migration delay relative to the effects of the thermal plume. This might just provide the first real insight into the effects of the plume on the shad population in the upper river. This would be a value added product that TC could contribute to the health of the river. State agencies and river advocates should have access to the metric system.

Study 23 Fish Impingement, Entrainment and Survival
TC will only be conducting a desktop review of literature regarding fish entrainment and impingement. That may be a viable first step but the study will not be undertaken until 2015, the second and last field season in the ILP process. Given the variable nature of rivers, no two are the same. CRWC is concerned that simply because a study on one river made a finding does not mean the situation is the same on the Connecticut River.

According to the draft updated plan, the reason for waiting until 2015 is that Study 23 will rely on other studies from the 2014 field season. CRWC feels that waiting until 2015 to conduct the desktop study is neither necessary nor protective of fish and other aquatic species in the Connecticut River.

TC does not need to know what species they are dealing with in the project areas while they are distilling information about the parameters of swim speeds, body dimensions and other characteristics for various species from other studies on other rivers. Determining the relationship between the desktop review and the actual species found in the project reach based on the 2014 field work can and should be done over the fall and early winter of 2014-15. TC could produce a matrix of specific standards protective of fish species referenced in the desktop work and once the actual species are known for the projects, those species can be placed into the matrix.

That timing for the preliminary results of the study would allow the working group, FERC, or both with cause in terms of findings of the desktop study to call for an additional on the ground study during the 2015 field season. Fish impingement and entrainment are too important as issues and should not rely on a last minute, no recourse desktop study.

- **Recommendation:** The fish impingement and entrainment study should begin in 2014 with the results of the desktop work prepared in such a way that field generated information gathered in 2014 can easily and quickly be applied to the fish species identified in the project reach of the river.

Study 24 Dwarf Wedge Mussels
CRWC has no further comments as the updated study plan incorporates the suggestions offered by CRWC and other working group members.

Study 25 Dragonflies and Damselfly Inventory
CRWC has no further comments as the updated study plan incorporates the suggestions offered by CRWC and other working group members.

Study 26 Cobblestone and Puritan Tiger Beatle
CRWC has no further comments as the updated study plan incorporates the suggestions offered by CRWC and other working group members.

Study 27 Floodplain, Wetland, Riparian and Littoral Habitats
The study narrative says that the study will stop at the face of the Vernon Dam. The topic of which company is responsible for the down river reach below Vernon Dam has been part of the working group discussions about this and several other studies. Although CRWC has been assured by FERC that there will be reach of the river left in a company dispute lurch we find that the fact that this statement remains in the update draft problematic. (pg 259 Study area and study sites)

- **Recommendation:** The study should not stop at the face of the Vernon Dam. All study plans should clearly identify an agreed upon location where one applicant's responsibility ends and the other start so there will be no reach of the river that is not surveyed.

This study brings up an issue about sharing the information on Rare, Threatened and Endangered species and habitats. It is an issue in other surveys as well. CRWC understands that circulating maps or other documents with exact locations of RT&E species puts those species at risk but the information generated about RT&E species is useful in other settings than this FERC relicensing. The presence or absence of RT&E species is information that all the stakeholders should have available to them.

- **Recommendation:** TC should make available to the Natural Heritage Programs of VT and NH all information about all RT&E species and habitats. Stakeholders should have access to the overall results about the identification of RT&E species with any sensitive location information redacted.

Study 28 Fowler's Toad
CRWC has no further comments as the updated study plan incorporates the suggestions offered by CRWC and other working group members.

Study 29 Northeast Bulrush
CRWC has no further comments as the updated study plan incorporates the suggestions offered by CRWC and other working group members.

Study 30 Recreation Facility Inventory, Uses and Needs
This study creates the same concern for CRWC mentioned above in Study 27. The language of where the survey will take place is not definitive as it says, "In addition, the study will inventory public recreation access opportunities at the Connecticut River from the upstream end of the Wilder impoundment to downstream limit of the Vernon project." Those present at the working group meetings know that TC and 1st Light do not define that point as the same location.

- **Recommendation:** The study plan should identify an agreed upon location, agreed between TC and 1st Light where one applicant's responsibility ends and the other's starts so there will be no reach of the river that is not surveyed.

Although the survey form includes questions about winter activity on the river, the survey itself is still planned to be conducted May through September. It would seem in this timeframe that winter recreation would get less of a response than what actually takes place on the river. As an example, a boating enthusiast or canoer may or may not be a winter ice fisher, yet ice fishing is a major activity in the setbacks throughout the three project areas.

- **Recommendation:** TC should invest some level of effort in surveying winter river users during the winter, especially ice fishers.

Whitewater river users are limited to one location in the project reach of the river, the one at Sumner Falls in Hartland, VT. The survey work there will be of value but more people probably paddle the USACE releases from the Ball Mountain and Townshend dams when they occur then you will ever run into at Sumner Falls.

- **Recommendation:** TC should survey, at least once some number of the participants present during the release at USACE flood control dams on the West River.

There is a difference in the usefulness of a concrete launch site to different segments of the boating public. Power boaters back up drop their metal boat and off they go. Car toppers (canoer, kayak, rowers) find cement damaging to their vessels because of the material used to create their vessels, some even as light as canvas. The historic construction of the cement docking facility has self selected what type of boater will use it. In order to reach out to the new and ever increasing number of people who do not powerboat on the river require venues for interviews other than with people using the existing dock areas.

- **Recommendation:** TC should contact canoe, rowing and other non-powerboat groups including those who sell people powered vessels and ask for their input about what attracts them to or keeps them away from the river.

There is no mention of the fish ladders or the visitor centers at any of the dams in this or any other recreation plan. CRWC hopes that this is an over site since the visitor centers are important for both public enjoyment of the river and education about the river. CRWC hopes that this lack of mention of the centers is not a lack of willingness to keep them open, in excellent repair, accessible to all with the intent to strengthen them as an education tool about the river, its uses and power production.

- **Recommendation:** The survey should test the public's knowledge and use of the visitor centers at the dams including what would make them more attractive as focal points for information about the health and uses of the river.

There may be an assumption built into the word "access" that the word includes Americans with Disabilities Act access to recreation sites. Whether or not a site is accessible to the standards of ADA should be spelled out in both the study plan narrative and in the recreation survey forms.

- **Recommendation:** The recreation study plan and survey forms should include information on specifically whether or not access points meet ADA standards.

The revised plan does speak to portage around the Bellows Falls station but there are issues with portage at the other dams. Vernon is either difficult to negotiate down the steep hillside to the launch area below the dam or you take the long walk on the road. The Wilder project has the same problem once you are off the macadam pathway. The pitch of the land is steep and then the flatter shore is usually littered with detritus making walking difficult.

- **Recommendation:** TC should evaluate all three of the portage paths around the dams in conjunction with canoe and other river user groups to increase user safety and portage reliability.

Study 31 Whitewater Boating Flow Assessment at Bellows Falls and Sumner Falls

CRWC has no further comments as the updated study plan incorporates the suggestions offered by working group members and CRWC has the clear expectation that TC will work with American Whitewater, AMC and NE Flow in completing the assessment.

Study 32 Bellows Falls Aesthetic Flow
CRWC has no further comments as the updated study plan incorporates the suggestions offered by CRWC and other working group members.

Study 32 Cultural and Historic Resources
CRWC has no further comments as the updated study plan incorporates the suggestions offered by CRWC and other working group members.

CRWC (and CRJC) would remind FERC and all members of the Cultural and Historic working group that private meetings among only certain of the stakeholders are counterproductive and potentially damaging to the credibility of this portion of the relicensing process.

CRWC Comments on Studies Rejected by the Applicant

TC rejected several studies for various reasons. Those that are of particular concern to CRWC are the recreation economic analysis and a study of the effects of climate change on river resources and on the projects.

Recreation Economic Analysis: One of the underlying tenets in the FERC relicensing process is that under the National Environmental Protect Act, power production is no longer the sole focus of FERC. The value of activities like recreation have their own and competing value with power production.

AMC, NE Flow and American Whitewater called for a contingent valuation study. TC has declined so far to conduct such a study. The point of a contingent valuation study is that it seeks to put two competing social goods on an equal footing, in this case recreation and power production. These economic studies assess the value of an activity for society and what may be lost if the activity is prevented from occurring. TC can put a value on the power they produce but without an economic figure for the recreation value there is nothing to put on the other side of the balance scale. FERC cannot balance the two values in this case, as they should, because one value will not be determined.

This lack of balance is not limited to on water activities alone. For those who do not boat but instead bird, hike, ski and wildlife watching face limited access to the river. If you do not boat and depending where you reside, you may not be able to experience New England’s greatest river at all. Most land along the river is privately owned so foot or motorized access to the river is limited to whom does one know who owns land along the river. As part of this relicensing process CRWC will ask the question, what can TC do about opening up the river for all types of river related recreation? FERC cannot answer the question without serious study of the economic value of those non-water river related outdoor activities.

- **Recommendation:** FERC should require TC to conduct an economic impact study on the value of a wide gamut of outdoor recreation activities including the value of whitewater opportunities.

Climate Change: Both the applicant and seemingly FERC have rejected the call for a study to determine the impact of climate change on project operations and the facilities themselves because they claim that such a study would not lead to license conditions. CRWC rejects that analysis. There are two main concerns about not conducting CRWC Study Request 4. They are: **A) -** affects of warming temperature on the water and **B) -** the impacts of higher than normal flows on the facilities themselves. Understanding each concern could lead to appropriate license conditions.

A) River water temperatures have been rising on a historic basis (Paul Jacobson, Charles Fredette and Nels Barrett, American Fisheries Society Monograph 9, 2004 and NOAA National Climate Center, Northeast 12 month average temperate for the period 1896 through 2012). There should be a clear understanding of at the three projects on whether or not the effects of the reservoirs exacerbate the documented temperature increase. There is no way to establish any mitigation measures to protect aquatic life without the base information on the effects of climate change combined with the effects of the reservoirs on water temperature.

B) Climate change means more frequent events of more intense weather. Heavier rain when it comes will create unusual higher flows. In winter the potential for higher snow pack combined with quicker melting and the possibility of mixing in heavy rain at the same time could create flooding conditions even beyond what TC models at this time under FERC emergency preparedness requirements. CRWC understands that the three projects are "run of the river" so our concern is not about storing water in an effort to mitigate flooding. CRWC knows that the dams will pass what water they must. Our concern here is that these intense higher flows will increase wear and tear on all three facilities. Increased damages or wear and tear on the facilities caused by more high flow events will have an impact on the economic analysis FERC must perform on the applications.

- **Recommendation:** TC should be required to conduct a study based on CRWC Study Request 4. In particular the study should rely on 30-50 year temperature increase models that incorporates thermal loading from the reservoirs. The other key element would be to anticipate how climate change predictions would affect management of high flow events at the three projects and evaluate if changes to the dam structures would mitigate adverse impacts on the facilities themselves.

Again we appreciate the opportunity to submit our comments on the revised draft plans for the proposed projects P-1904 (Vernon), P-1855 (Bellows Falls), P-1892 (Wilder). We hope you will take our recommendations to heart and by doing so the revised studies will give all of the stakeholders the information we need to consider in order to develop appropriate recommendations for license conditions.

Sincerely

David L. Deen River Steward

Frederick William Lipfert Jr., Cornish, NH.
F. WILLIAM LIPFERT, JR., AND JENNIFER LIPFERT
1349 NH Route 12A
Cornish, NH 03745

July 15, 2013

Kimberly D. Bose, JD, Secretary
Federal Energy Regulatory Commission
888 First Street NE
Washington, DC 20426

Re: Wilder Project (FERC Project No. 1892-026) and Bellows Falls Project (FERC Project No. 1855-045) – Comments on Study Plan

Via e-file

Dear Secretary Bose:

The undersigned are owners of land in Cornish and Claremont, New Hampshire, with approximately one mile of frontage on the Connecticut River downstream from the Wilder Project. Our land is subject to Bellows Falls Flowage Rights.

This letter constitutes our comments on the proposed study plan for the subject relicensing. At the May 16th TransCanada and FERC meeting in White River Junction, TransCanada Project Manager John Ragonese stated that “only one operational alternative will be studied.” When queried about this unusual stance, given that the National Environmental Policy Act calls for all “reasonable alternatives” to be studied, Mr. Ragonese stated “If we find any problems with the results of any of the studies, we’ll go back and add alternatives later.”

Mr. Ragonese rejected our formal request for the inclusion of a second operational alternative in the studies. This second operational alternative would limit the rate of change of outflow of the dams, such that the transition from minimum flow to maximum flow would take place over the course of some minutes – rather than the current operational practice of a near-instantaneous change.

A July 2012 report by the Upper Valley Land Trust (a 501(c)3 organization that holds a conservation easement on a portion of our land) notes that a 1968 survey entitled “Property of Harrison E. Miles prepared by Breckenridge Land Surveys” records the distance from the railroad tracks to the river’s edge of our property as 622 feet. The Land Trust measured this distance in the summer of 2012 and found the distance to be 490 feet – an alarming 132-foot longitudinal loss of land. Multiplying this distance by the 30+ foot bank height and hundreds of feet of frontage, this equates to thousands of cubic yards of material that have been lost. This significant erosion jeopardizes agricultural soils of statewide significance and threatens the existence of the endangered dwarf wedge mussel. As you know, the dwarf wedge mussel (Alasmidonta heterodon) is classified as an endangered species by the federal government. According to the U.S. Fish and Wildlife Service, this mussel once inhabited much of the mainstem of the Connecticut River and many of its tributaries but now is found at only four sites in the watershed – including the frontage along our property. The U.S. Fish and Wildlife service notes that "siltation…degrade[s] mussel habitat."

We attribute the significant erosion problem on our property to rapidly fluctuating water levels on the river caused by the operation of the Wilder Dam. Our children have seen shoes, towels and swim gear swept downstream because the change in water level is so rapid on summer afternoons that they cannot react in time. Wilder Dam operation has caused kayaks to capsize and has resulted in at least one fatality (a local fisherman whose hip waders became flooded due to rapidly rising water level, resulting in drowning).

It is our understanding that flow from the dam can vary from a minimum of 700 cubic feet per second (cfs) to the facility's full hydraulic capacity of 10,700 cfs. This change in flow – a 15-fold increase in water volume – can occur almost instantaneously. Our concern stems not from any particular flow rate assumed in the studies but, rather, from the lack of any operational alternatives that address reasonable limitations in rate of change in flow.

We request that TransCanada be requested to add a second operational alternative, one with a limitation in rate of change in flow of 5000 cfs per hour (that is, requiring the operator to transition from minimum flow to full hydraulic capacity over two hours when practicable to do so). We believe TransCanada's suggestion that it will revisit operational alternatives at a later date should study results warrant to be inconsistent with NEPA.

You can reach us at the above address or at 1-603-448-8738 (days) or 1-603-675-9110 (evenings) should you have any questions. We look forward to your response.

Very truly yours,

F. William Lipfert, Jr.   Jennifer Lipfert

cc: Kenneth Hogan, FERC

NITHPO

NARRAGANSETT INDIAN TRIBAL HISTORIC PRESERVATION OFFICE
Narragansett Indian Longhouse
4425A South County Trail
Charlestown, RI 02813

14 July 2013

NITHPO TRIBAL CONSULTATION ON FIRST LIGHT & TRANSCANADA's
FERC RE-LICENSING OF HYDRO-ELECTRIC PROJECTS ALONG THE MIDDLE CONNECTICUT RIVER:

The Federal Energy Regulatory Commission (FERC) has before it the consideration of permit re-licensing of the hydro-electric projects of First Light Hydro Generating Company (Project Nos. P-1889-081 and P2485-063) and TransCanada Hydro Northeast Inc. (Project Nos. P-1892-026, P-1855-045 and P1904-073). Said projects are considered to extend more than 160 miles along and within the Middle Connecticut River.

Pursuant to Section 106 of the National Historic Preservation Act, the Narragansett Indian Tribal Historic Preservation Office (NITHPO) has been invited to consult, has agreed to consult and herewith, in writing, affirms our religious, cultural and Tribal historic concerns and our consultation on this FERC re-licensing of the First Light Hydro Generating Company and TransCanada Hydro Northeast Inc. hydro-electric projects on the Middle Connecticut River.

The specific projects are the Wilder Project (P-1892-0260), the Bellows Falls Project (P-1855-045), the Vernon Project (P-1904-073), the Turners Falls Project (P-1889-081), and Northfield Mountain Pumped Storage Project (P-2485-063).

These re-licensing projects are federal undertakings, as defined by the National Historic Preservation Act (NHPA). The Act informs us that,

> *"When Indian Tribes … attach religious and cultural significance to historic properties off Tribal lands, section 1019(d)(6)(B) of the act requires Federal agencies to consult with such Indian Tribes…."* 800.2(c)(2)(ii)(D)

And that the Agency (FERC)

> *"…shall ensure that consultation in the Section 106 process provides the Indian Tribe … a reasonable opportunity to identify its concerns about historic properties, advise on the identification and evaluation of historic properties, including those of traditional religious and cultural importance, articulate its views on the undertaking's effects on such properties, and participate in the resolution of adverse effects."* 800.2(c)(2)(ii)(A)
>
> *"The Agency official shall plan consultations appropriate to the scale of the undertaking and the scope of the Federal involvement and coordinated with other requirements of other statutes, as applicable, such as the National Environmental Policy Act, the Native American Graves Protection and Repatriation Act, the American Indian Religious Freedom Act, the Archaeological Resources Protection Act and agency-specific legislation."* 800.2(a)(4)

NHPA CONSULTATION: In the implementation of the NHPA, under state permits, archaeologists will usually serve as the SHPO's consultation data gathers. Operating from a Tribal cultural frame of reference, Tribes usually gather our own data to inform the Tribal NHPA consultation process. However, this data gathering is often done in field collaboration with the archaeological process.

REGIONAL TRIBAL HISTORIC BACKGROUND:

The contemporary hydro-electric companies are the contemporary primary stewards of the Middle Connecticut River. The petroglyphs now hidden by the risen waters at Wantastiqett, the mouth of the West River above Vernon Dam just beyond the Connecticut River, is only one of the many indicators that Tribal cultural resources of the ancient residents of the River have survived colonization's transformative impacts and under this FERC permitting process require Tribal identification and recommendations of protection. What special attention will be given to identify, protect and preserve the remnants of the life ways of the Tribal People whose home the Middle Connecticut was for millennia prior to the arrival of the Colonists?

NARRAGANSETT RELATIONS: The Narragansett Tribe, prior to European contact, was one of the many Tribal peoples to use the middle Connecticut River as a thoroughfare of trade, communication, ceremony and intermarriage with its cousins, the Pocumtuc, Abenaki, Pennacook and Anishinaabe/Ojibwe Bands, further north. During the period that is referred to as King Philip's War, Canonchet – Chief Sachem of the Narragansett, gathered in council with other sachems at Squakheag (Northfield, MA) to determine the course of the War. Tribal oral history is corroborated by the historical accounts of historian George Shelton who, in his <u>History of Deerfield</u>, cites of Canonchet that, *"His plan, which he laid before the Sachems in council, was to make this region (Peskeompskut/Wissatinnewag -- Turners Falls) the general rendezvous, and place of refuge for the old men, women and children, with a party of his own men, who were on good terms with the Mohawks, for a guard."* For thousands of years prior, this bend in the Connecticut River was a place of welcome and annual harvest of the ocean fish that congregated at the falls as they came up river to spawn. The joy and celebration that this place was always known for was suddenly broken in the dawn hours of May 19, 1676. Capt. William Turner and his militia commenced their slaughter of hundreds of women, children, elderly and war wounded. This event is remembered as the Turner's Falls massacre. The ancient joy and spirit of cerebration has yet to return.

NORTHERLY REFUGE: For nearly a century following the presumed end of King Philip's War, the descendants of Tribal combatants who had taken refuge with their cousins in Tribal towns and settlements further up the Connecticut, made raids down the Connecticut to reclaim Deerfield and other Tribal villages and towns that were of great significance and ceremony. Where along the Middle Connecticut River are the remnants of those villages of refuge for the war weary and war dispossessed? Where are the burial grounds of the walking mortally wounded. Where are those communities that planned and executed return raids in attempts to re-take their birth places, their ancestral communities and ancestral burial and ceremonial grounds, the ancient places of "home" that were becoming "home" to the colonizing strangers? How shall we (the Federal Agency, the project proponents, the Tribes) collaborate in utilizing NHPA, NAGPRA, AIRFA & ARPA in these Middle Conneticut River project's areas of potential effect?

INITIAL ONE YEAR PROPOSAL

PROBLEM TO BE SOLVED: How will these FERC re-licensing projects <u>foster and facilitate</u> meaningful Tribal Historic Preservation research and safeguards. No Tribe wishes to serve merely as historic preservation window dressing. Within the generally proposed area of potential effect of these re-licensing projects, impacts to sites of Tribal history and potential impacts to cultural resources loom as significant concerns. The broad brush strokes of research by non-Tribal researchers often generalize and blur the significance of Tribal historic and cultural sites as well as the locations and significance of surviving ancient native flora.

SOLUTION: From a Tribal Historic Preservation perspective, we wish to examine for ourselves the proposed APE and offer our own evidence based advisories. Normally, this is done in tandem with the standard survey process. From the Tribal cultural perspective, we seek to implement the identification efforts specified in the NHPA as *"background research, oral history interviews, sample field investigations and field survey."* **800.4 (b)(1)**

EVIDENCE BASED PROCESS: Based upon the cultural evidence found in the examination of the APE and the potential of the impacts indicated by the re-licensing, a single or a multi-year involvement may be required for the Tribal survey and monitoring processes.

TRIBAL DATABASE DEVELOPMENT: First Light and TransCanada have offered NITHPO currently available archaeological reports representing some of the known Tribal cultural resource find spots. The data in these reports will have to be transferred into a Tribal culture and Tribal process based data retrieval program. In the proposed Tribal site examinations, Tribal personnel will be guided by culturally reinterpreted information from this program as to where to apply Tribal culturally based research techniques in a given area of concern. Field findings and oral history from these site examinations would be returned and entered in order to keep the database updated.

TRIBAL DATABASE USE, DURATION & RESPONSIBILITY: Representatives of the Nolubeka Project will assist NITHPO in the development of the database and the implementation of the field monitoring and data gathering operations. Senior retired regional archaeologist, Mitch Mulholland has agreed to advise our database development. This database, once established, will continue to support the Tribal historic preservation needs of the hydro-electric projects over the next 5 to 50 years, on an as needed basis. The operations center will be in Turners Falls. The database will be accessible to other Federally Recognized Tribes and recognized scholars. This facility shall be available to serve as a regional historic preservation base for Tribes. Recently, eroding Tribal burials in the banks of the Connecticut were archaeologically surveyed without Tribal monitoring or ceremonial participation. Such inter-cultural protocol breeches on the part of the hydro-electric companies should be a thing of the past. A cultural resource response agreement would be an appropriate bi-product of this consultation and database development process.

ONE YEAR AGREEMENT: Based upon the ongoing historic preservation scope of the project, the agreement may be re-negotiated annually. Prior to detailed scoping and negotiations, the first year projected agreement would cover and cost:

(1) Cost of initial database development personnel	(3)	-	$35,000
(2) Facility rental & equipment		-	$25,000
(3) Ongoing cost of database input personnel	(2)	-	$20,000
(4) Cultural resource field survey personnel	(3)	-	$33,000
(5) Lodging, per diem, mileage, liability insurance	(3)	-	$15,000
(6) Senior Archaeological Research Consultant	(1)	-	$12,000
(7) NITHPO Tribal Cultural Resource oversight		-	$19,200

Projected Total -- $159,200

SHARED COST: It is proposed that First Light and TransCanada would share this One Year Agreement Cost proportional to their percentages of the linear APE mileage within these permitted projects on the Middle Connecticut River.

CONTACT: **DOUG HARRIS – PRESERVATIONIST FOR CEREMONIAL LANDSCAPES/NITHPO**
(401) 474-5907 <dhnithpo@gmail.com>

United States Department of the Interior

NATIONAL PARK SERVICE
NORTHEAST REGION
15 State Street
Boston, Massachusetts 02109-3572

IN REPLY REFER TO:

July 14, 2013 Filed Electronically

Kimberly Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

NPS Comments on Updated Proposed Study Plans for TransCanada Hydro Northeast, Inc. Wilder Hydroelectric Project No. 1892-026, Bellows Falls Hydroelectric Project No. 1855-045 and Vernon Hydroelectric Project No. 1904-073.

The NPS appreciates the opportunity to have participated in several face to face meetings between the applicant and their consultants, FERC and numerous stakeholders in order to address comments received on the PSP and to refine the proposed studies based on that input. The following comments are filed in order to assist the applicant in their data collection and analysis.

General Comments

The Connecticut River and its 7.2 million-acre watershed includes National Forests, National Historic Sites, National Wildlife Refuges, National Scenic Byways, Partnership Wild and Scenic Rivers, National Recreation Trails, National Natural Landmarks, Important Bird Areas, and segments of the New England National Scenic Trail; the Appalachian National Scenic Trail; the East Coast Greenway Trail; the Northern Forest Canoe Trail; Revolutionary Route National Historic Trail, a Ramsar wetland site, and an American Heritage River, and approximately two million acres of public and private conservation land.

These projects are located on the nation's first National Blueway, so designated by DOI Secretary Salazar on May 24, 2012. Secretary Salazar noted that "The Connecticut River Watershed is a model for how communities can integrate their land and water stewardship efforts with an emphasis on ‘source-to-sea’ watershed conservation [as we] seek to fulfill President Obama’s vision for healthy and accessible rivers that are the lifeblood of our communities and power our economies.” Among the stated goals are to advance a whole river and [utilize] a water-based approach to conservation, outdoor recreation, education and sustainable economic opportunities in the watersheds in which we live, work and play.” As such, these relicensings present a once in a generation opportunity to address and correct deficiencies in recreational opportunities. Therefore, it is critical that in attempting to reach users and equally important, those who for whatever reason do not use the river, the survey’s content and method for reaching current and potential recreational users must be adequate.

Land Protection

A comprehensive identification of licensee owned lands adjacent to the project boundary should be included in the application. GIS data can be overlain to show the project boundary, lands adjacent to it and areas which if developed could adversely impact river resources, from development and impact on aesthetic values to upland land use practices that may adversely impact water quality and sedimentation. In some cases, these adjacent lands could be appropriate for providing additional recreational access to the river, new trails or connections to existing trails. Permanent protection of these lands would also confer aesthetic benefits to those using the river by providing views from the river of undeveloped lands. Regarding lands within the project boundary, those not integral to project operations should be permanently preserved and in many cases consist of prime agricultural lands. Even those lands currently under Agricultural Preservation Restrictions are only temporarily protected. Permanent protection ensures the long term viability of these important resources. Numerous non-governmental organizations and federal, state and local entities have identified valuable and important land protection locations and opportunities along the Connecticut River. This information should be identified and used collectively to determine appropriate opportunities for land protection in the context of these relicensing proceedings.

Study #30, Recreation Facility Inventory and Use & Needs Assessment

Numerous RAs and NGO noted that this study would be considerably improved if it were to capture non-users, including those who may have used project related facilities in the past and no longer do so and those potential users who for various reasons, do not utilize project area facilities. Several methods for capturing those users and their input were identified. In brief, the NPS believes it would be simple, cost effective and produce useful data if the applicant were to avail themselves of the MA, VT and NH members of organizations such as the Appalachian Mountain Club (AMC), whose members would logically have an interest in recreating on the Connecticut River. The AMC has graciously offered to work with the applicant to transmit updated survey questionnaires to their membership in the project area. AMC has also developed a recreation plan for the Connecticut River Blueway, referenced above.

Extensive work has been done by the Friends of the CT River Paddlers Trail relative to river access campsites in terms of appropriate frequency (how far apart on the river) as well as maintenance and facility needs. Efforts are underway to expand the trail into Massachusetts and Connecticut. This data should be incorporated into the study in order to identify obstacles to multi-day paddling trips, which also include the lack of adequate or existing portages around project dams.

Additional information and resources were identified in the PSP meetings and should be utilized to refine the study. These include City of Hanover owned conservation lands abutting the impoundment just south of the Hanover town line, numerous developed trails with no river access, a proposed public access south of the Westborough River which is awaiting the completion of a bridge project on long term hold, Two Rivers Park Natural Area (Mascoma River confluence below Wilder) includes developed trails, and sites approved for recreational activity, but as yet unbuilt. This park includes a mandate for public access and is part of West Lebanon's Master Plan process which included 38 public meetings. The area includes over ½ mile of riverfront. They In addition, an area developer who attended the meetings noted that he has offered to allow access on a 15 acre part of his site as well as adjacent lands suitable for trails.

The revised study should include a comprehensive assessment of the condition of each site, along with how various ratings (good, fair or poor) are defined and applied. As noted during the meetings, there are situations where the presence of a boat ramp may actually limit access for certain kinds of users. Concrete ramps may be unsuitable for hand carried boats, where sites with a small floating dock can allow these users to access the river. Simply identifying a boat ramp does not provide adequate information for the types of users and potential deficiencies.

The revised study should extend the time it is to be conducted beyond Sept 30, allowing it to capture users in the fall and winter seasons which may well account for significant use. The survey also does not account for use by minors; however, by utilizing AMC data, for instance, those users will be identified through family membership data. The revised study should also include a method to reach school groups. Although the towns may or may not have that data, queries should be put to area schools to ID which of them go on field trips and equally important, why they may not visit river based recreational facilities nearby. Additionally, the study data collection phase should extend to two years to allow for vagaries in weather and economic conditions which change from year to year. A single field season may provide good data, but a second year is certainly preferable. The field surveys should also extend to ½ hour before sunrise and ½ hour after sunset. The current proposal to start them ½ hour after sunrise and end ½ hour before sunset will miss many if not most anglers who tend to put in before sunrise and/or may take out after sunset.

The adequacy of the portages at each dam must also be addressed in order to cure existing deficiencies in the opportunities for multi-day paddling trips. Bellows Falls is currently the most problematic of the three, but all need to be adequately addressed.

Study #33, Historical and Cultural Objects.

The applicant currently possesses historic photos and documents related to the dam's construction. These resources should be adequately documented and preserved in association with local historical societies and/or town archivists.

The NPS appreciates the opportunity to work with the applicant to revise their proposed studies in order to provide the FERC with adequate information on which to base their licensing related decisions. Therefore, the NPS requests that the FERC direct the licensee to revise its proposed study plans to address the concerns raised above.

Questions or comments on this submittal should be addressed to Kevin Mendik at kevin_mendik@nps.gov or by phone at 617-223-5299.

Respectfully submitted,

Kevin R. Mendik
NPS Hydro Program Manager
Northeast Region

New England *FLOW*~~~~~~~~~~~~~~~~~~~~~~~~

252 Fort Pond Inn Road, Lancaster, MA 01523 Tel. (978) 331-4889 FAX: (978) 728-4544 Email: tom.christopher @ comcast.net

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

TransCanada Hydro Northeast, Inc. Wilder Hydroelectric Project No. 1892-026
Bellows Falls Project No. 1855-045
Vernon Hydroelectric Project No. 1904-073

NEW ENGLAND FLOW'S COMMENTS ON UPDATED PROPOSED STUDY PLANS FOR THE WILDER HYDROELECTRIC PROJECT, FERC PROJECT NO. 1892-026, THE BELLOWS FALLS PROJECT, FERC NO. 1855-045, AND THE VERNON HYDROELECTRIC PROJECT, FERC. NO. 1904-073.

Since 1998 New England FLOW (FLOW) has promoted the protection, enjoyment, and understanding of the mountains, forests, rivers, and water trails of the New England region. FLOW is the oldest coalition of whitewater boating groups in the Northeast whose members, many of whom live within short driving distance from the Connecticut River and would enjoy these sections as a day-long or longer trips or as a whitewater opportunities.

Representatives of New England FLOW attended face-to-face sessions held by TransCanada on June 6 and 7, 2013, at White River Junction to discuss the proposed study plans. We reference our comments made at those meetings.

First of all, we want to compliment TransCanada for selecting qualified consultants to administer these studies. The consultants acknowledged our suggestions at the face-to-face meetings, were cooperative, and displayed a good knowledge of the river. Our comments below are intended to help them gather more and better data from their surveys and research.

Summary of comments:

In this filing, we emphasize that TransCanada should also survey non-users of the river, who may have been pushed away by a lack of recreation facilities or by facilities that are not suited to their forms of recreation. In addition they should employ more qualitative forms of research such as focus groups. We suggest the applicant consider a wider range of facilities and options in its inventory and assessment of recreation facilities. We make what we consider important comments about the portage trail around the Bellows Falls Dam, the whitewater boating study in the Sumner Falls reach and the Bellows Falls bypass reach, and the failure of TransCanada to conduct a contingent valuation study.

Comments on specific studies:

Study #30, Recreation Facility Inventory and Use & Needs Assessment

We feel a wider range of facilities and options should be considered for the inventory assessment. As one example, if a concrete boat ramp is present at a put-in; most inventories simply indicate a ramp. Concrete boat ramps, however, are generally most useful for people towing motorboats on trailers. Such ramps damage wood, fiberglass, and other kinds of car-top boats such as canoes, kayaks, small sailboats, and rowing shells. The presence of a concrete boat ramp suggests the site favors motorboats. If, however, there is a sandy or wooden boat ramp, then owners of self-propelled watercraft would find the site useful. If you ever have a chance to drive along the Charles River in Boston during the summer, you'll notice that the boat ramps from the grand boathouses on the Charles are made of wood. Such distinctions could be helpful in this inventory.

At the meeting in White River Junction, we suggested surveying a wider group of users and especially of non-users of the TransCanada facilities. Contacting non-users can be helpful in identifying areas where TransCanada might strengthen its recreational facilities and offerings to serve a larger public. While some of this is planned, we encourage TransCanada to expand this survey of non-users.

Such surveys can be more cost effective and cover a wider audience by including mailing lists of NGOs, such as the FLOW, American Whitewater and the Appalachian Mountain Club, which collectively can provide has thousands of relevant survey contacts in the region. The only bias in these group is an interest in the outdoors and water-based recreation. Rather than securing lists of people who may have no interest in the river, it would be more efficient, cost-effective and informative to use NGO lists, where by definition the group has some interest. Ken Hogan of FERC commented to TransCanada that it is common in FERC processes to look at NGOs and municipalities that have recreation plans or development plans in the region.

We suggest that TransCanada engage in a broader range of survey techniques that produce more qualitative results and greater accuracy, such as focus group interviews. Such surveys are far more informative than paper surveys handed out at recreation sites, but they do take a bit of time.

We are concerned about projecting future uses of the river using national models. Predictions of the future are always speculative, and using "standard sources" emphasizes regression to the mean rather than providing any useful information. FLOW agrees with Adam Beeco from FERC that more updated literature on doing future research is needed for this study.

We have questions about the standards employed to assess the sites already on the river. How is overcrowding measured, or even determined? Exactly what facilities would one expect to find at different kinds of campgrounds? We recommend looking at the extensive work done by the Connecticut River Paddlers' Trail to define what constitutes adequate campground frequency and equipment.

This is as good a time as any to mention the portage trail around the Bellows Falls Project. It is abysmal. The improvement of the portage may come under any number of studies, including #30, #31, #32, and #33. As Adam Beeco of FERC commented, a shorter, safer portage plan is needed at this project. The portage should be addressed somewhere in these studies. The portage at the Wilder Dam is nearly as bad, and an alternate route on the other side of the river has been suggested. The portage at the Vernon Dam also has issues.

Study #31, Whitewater Boating Flow Assessment:

The mechanisms of controlled-flow whitewater evaluations at sites such as Sumner Falls and Bellows Falls are widely known and have been used on many rivers. We believe the keys to successful evaluations include working together with NGOs to obtain the right mix of paddlers in the right mix of craft, having controlled flows that provide a good range of conditions, and using good evaluation survey forms with the boaters. Members of the New England FLOW, American Whitewater, and the Appalachian Mountain Club have participated in several successful controlled-flow studies during FERC relicensings on other New England rivers for over 20 years. We look forward to working with TransCanada's consultants as they get closer to the study.

Sumner Falls has been used as a play spot by kayakers for years. The appropriate range of flows is known, and the waves that form even have names. This should be a straight-forward project. Timing may be an issue, as well as achieving some of the higher flows that are greatly valued at the site.

Bellows Falls is a different situation because we know very little about this whitewater reach. We can scout it at various flows, but we won't really know until the boaters hit the water. We appreciate that opportunities have been built into the study for scouting and appraisal by expert boaters before the controlled-flow study begins. That should help us determine the appropriate size for evaluation flows, however all flows should be evaluated and include local boaters who have a range of experience on different rivers if an accurate assessment of flow is to be achieved. Even those predictions may need to be modified after the initial runs.

It is important that calculated flows in the bypass reach be accurate. TransCanada does not have much experience in providing precise-controlled flows from its dam above the Bellows Falls bypass reach. Concerning the gates available to release water at the Bellows Falls bypass reach, TransCanada said (p. 226): "The minimum gate opening for these gates is 1 foot to prevent river debris from damaging the submerged seals or getting lodged and preventing the closure of the gate. Considering the overall 3-foot range of operation of the impoundment, a 1-foot opening discharges 3,000 to 3,300 cfs into the bypassed reach."

We have no idea what a decent flow would be in the bypass reach. A flow of 3,000 cfs or higher might well be appropriate. The flows provided for evaluation should be measured exactly, rather than being estimated. Any sloppiness in this area can create problems after the license is issued. We understand that sometimes it is difficult with large hydropower gates to exactly measure flows. Again, we look forward to working closely with the consultant to learn which flows can safely provide maximum opportunities for whitewater recreation.

In conversations at White River Junction with the consultants who will be running this study, we felt they were well-informed on the situation. One unresolved issue is what to do about the low-head fish barrier dam near the bottom of the bypass reach. The FLOW, AW, and AMC favor removing the dam. TransCanada has refused requests to remove the dam prior to this study. Their consultants state they had been studying the dam under different natural flow conditions and they believe it is runnable. FLOW will want to take a close look at it and the boaters in the test runs will make their own decisions about that.

Since TransCanada also has several legitimate issues with that low-head fish barrier dam with other stakeholders, we proposed in White River Junction that a subgroup of these stakeholders look into the positive benefits such as removal, modification, future uses, and so forth. In published comments after the meeting, TransCanada said, "There may be many considerations for the dam positive and negative relative to other resources and we feel we can assess flows without removal." But the creation of a subgroup was not addressed and given the multiple benefits of dam removal, we consider this position particularly short-sighted. We recommend the creation of such a group, which can work cooperatively with TransCanada to better understand the issues and the option of removal.

We look forward to reviewing the evaluation forms, and to doing the preliminary examinations and site visits that will be possible prior to conducting the controlled-flow study.

Study #33, Historical and Cultural Objects:

This study does not address our request to preserve photos and historical documents in possession of TransCanada related to the construction of the dams. These are historical materials in possession of the applicant that need to be inventoried and plans devised for their preservation.

Note on a study not done:

TransCanada has declined requests to do a contingent valuation study of whitewater in the Bellows Falls bypass reach.

Contingent valuation studies seek to put two competing social "goods" on an equal footing. They do this by assessing "value," that is, the value of an activity for society and what may be lost if the activity is prevented from occurring. Value is different from revenues, in the business sense. A tobacco company may make a lot of money, but that does not necessarily give it a value in society.

In contingent valuation studies at hydropower dams, we have one activity that can easily express itself in dollars—hydroelectric generation. Such generation comes from the public's river water run through turbines. Other activities may compete for that water and reduce company revenues. How are we to compare the value of a shad in the Connecticut River above any of the TransCanada dams? How can we value the recreation generated by putting river water back into the natural stream bed for whitewater recreation? How do we compare the scenic beauty of a natural river with the lost revenues when a bypass reach takes some water from the turbines? Comparing such activities as fish, recreation, and beauty using revenues and dollars earned works against the fish, the boaters, and the public. Contingent valuation was a technique produced to compare those activities on an equal footing.

We don't do that anymore with fisheries or scenic values, but at one time it was done. Rather than dealing with dollar revenues, the term "value" was used. Contingent valuation places a value on different activities based on the social goods produced. The shad in the river have a social value. Recreation in the natural stream bed has a value. Beauty has a value. Flipping a

switch and having the lights turn on has a social value. Contingent valuation studies are how these things are put in the same framework so they can be compared.

We understand that TransCanada may wish to avoid such comparisons. For one thing, the social value of hydropower is diminished when a company charges a profit to provide electricity. But that's the nature of the world.

We cannot force TransCanada to do a contingent valuation study, or FERC to order one, but this metric is clearly relevant in determining value. But lacking a study of comparative social values, we do not want to hear TransCanada arguing during the mitigation phase of relicensing that they cannot provide one thing or another because it would cost them too much money. That argument goes out the window with the rejection of contingent valuation studies.

Conclusion:

New England FLOW respectively requests that FERC accept these comments and direct the licensee to revise its proposed study plans to address the concerns raised. Thank you for considering these comments.

Respectfully submitted this 10th day of July, 2013

Thomas J. Christopher

____

Thomas J. Christopher, Secretary/Director
New England FLOW
252 Fort Pond Inn Road
Lancaster, Massachusetts 01523

The State of New Hampshire
DEPARTMENT OF ENVIRONMENTAL SERVICES

Thomas S. Burack, Commissioner

July 15, 2013

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, D.C. 20426

RE: Comments on Updated Proposed Study Plan for FERC No. 1892 (Wilder), 1855 (Bellows Falls) and 1904 (Vernon)

Dear Secretary Bose:

The New Hampshire Department of Environmental Services (DES) is responsible for issuing federal Clean Water Act § 401 water quality certifications (401 certifications) in New Hampshire. State statutory authority for issuing 401 certifications is provided in RSA 485-A:12, III. DES is also responsible for establishing and administering surface water quality standards for New Hampshire.

DES has reviewed the Updated Proposed Study Plan filed by TransCanada on July 8, 2013 for the following three hydroelectric projects on the Connecticut River:

Wilder Project (FERC No. 1892)
Bellows Falls Project (FERC No. 1855)
Vernon Project (FERC No. 1904)

Comments on the Updated Proposed Study Plan are attached. Please note that DES also supports the comments submitted by the New Hampshire Fish and Game Department in a letter dated July 11, 2013.

We thank you for the opportunity to comment. Should you have any questions, please do not hesitate to contact either myself (602-271-2983) or Owen David (603-271-0699.

Sincerely,

Gregg Comstock

Gregg Comstock, P.E.
Supervisor, Water Quality Planning Section
New Hampshire Department of Environmental Services

July 15, 2013
New Hampshire Department of Environmental Services(NHDES)
Comments on
TransCanada Hydro Northeast Inc (TC)
Updated Proposed Study Plan (PSP) dated July 8, 2013
for
Willder Hydroelectric Project (FERC Project No. 1892-026)
Bellows Falls Hydroelectric Project (FERC Project No. 1855-045)
Vernon Hydroelectric Project (FERC Project No. 1904-073)

General Comments:

1. The extent of TransCanada's and FirstLight's study responsibilities downstream of the Vernon dam should be clarified so that study plan responsibilities can be assigned appropriately. It is our understanding at this time that TransCanada's studies will extend to the NH/MA border.

2. Many studies mention stakeholder workgroups (such as the erosion working group for Study #2) that will be consulted prior to and during various stages of the studies. NHDES requests to be on these working groups.

Relationship Between TransCanada and FirstLight Projects
NHDES Comments:

p.4, last paragraph. It is stated that "... evaluation of Vernon Project impacts to the section below Vernon dam has been included in the updated study plans." The distance downstream of the dam should be stated.

TC Proposed Study #1: Historic Riverbank Position and Erosion Study
Relevant NHDES Study Requests: 21a, 21b, 21c.
NHDES Comments:

p. 17, Analysis. It is stated that this study will attempt to correlate bank loss to a specific period or time frame, historical hydrological events, or other causal agents. NHDES requests that "other causal agents" include historical changes in the operation of the three projects. This information should provide further insight as to how project operations have potentially affected riverbank erosion.

TC Proposed Study #2: Riverbank Transect Study
Relevant NHDES Study Requests: 21a, 21b, 21c.
NHDES Comments:

p. 19, Study Goals and Objectives, 1st paragraph. This section states that the goal is to monitor riverbank erosion at selected sites in the impoundments and project-affected riverine sections below the Wilder and Bellows Falls dams. This sentence should be revised to include sites up and downstream of the Vernon dam which would be consistent with p. 21, Study Area and Study Sites, where it is stated that 4 transects associated with the Vernon dam will be monitored.

p. 22, Establishing Monitoring Sites and Repeat Surveys. The accuracy of the topographic, bathymetric and repeat surveys should be specified. It is stated that data will be collected at sufficient density to accurately describe the slope geometry. This should be specified. The density will need to be quite high to detect changes in riverbank geometry that may be primarily attributable to project operation. In its study request, NHDES proposed installation of horizontal pins into the bank to help measure erosion over the short and long term. If the density of survey points is not considered high enough to detect subtle changes in riverbank geometry, NHDES will likely request that pins be installed as described in its original study request.

p. 22 and p 23, Repeat Surveys. On p.22 it is stated that surveys at the 20 sites will be resurveyed and ground photographs retaken at least four times per year for 2 years. On p. 23 it is stated that while NHDES and others requested monitoring of several bank transects on a biweekly basis for one year at 18 monitoring stations (three in each impoundment and three downstream of each dam), this additional monitoring is not incorporated into this study as such information will only be valuable if active soil loss occurs nearly continuously throughout the year. This assumes that soil loss is not occurring continuously with no data to support this assumption. To determine if soil loss is occurring nearly continuously and to help isolate the potential affects of daily project operation on riverbank erosion and instability NHDES requests that biweekly surveys be conducted throughout the year as originally proposed in our study requests.

p. 23, Surface Water Level Monitoring. The accuracy of the pressure transducers used to measure water levels should be specified. This section also states that the pressure transducers will be removed during the winter months to avoid breakage but that since flow variation is generally limited in the winter months, the absence of data collection in the winter months should not alter study results. NHDES disagrees that the absence of water level data in the winter months will not alter results. As shown in the figure provided in our study request that is based on data from the USGS gage located downstream of the Bellows Falls Project in North Walpole, water levels due to project operation fluctuated significantly in January 2013. The study plan should therefore address how water level fluctuation in the river during the winter will be accounted for and how it could potentially impact erosion along the riverbank.

TC Proposed Study #3: Riverbank Erosion Study
Relevant NHDES Study Requests: 21a, 21b, 21c

p. 26, Study Goals and Objectives. Consistent with our study requests, the objectives of this study should address the following:

1. determine how water level fluctuations within the minimum and maximum operating range and discharges from peaking operations at the Wilder, Bellows Falls and Vernon hydroelectric projects contribute to shoreline erosion;

2. identify and determine the effects of shoreline bank erosion and riverbank failure on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.);

3. identify techniques that could be used to mitigate the effects of project operations or other mitigation techniques that could be developed to reduce on riverbank erosion within the impoundment and downstream of the tailrace.

p. 31, Stratigraphic Descriptions, last sentence on this page. The accuracy of the survey grade GPS should be specified.

p. 33, Analysis and p. 34 Deliverables. The study should compare the water elevations due to project operation to the elevation along the riverbanks below which there is a lack of vegetation, undercutting, etc. and determine if there is a correlation. The study should also address the potential of daily project operations making the riverbanks more prone to massive erosion (i.e., due to lack of vegetation, undercutting, etc.) and how this may impact the frequency and magnitude of erosion when high flows occur.

The study should also address how daily project water level fluctuations may impact groundwater levels and movement within the riverbank and the extent to which this may be destabilizing the banks and making them more prone to erosion failure under higher flows.

The analysis should also evaluate how changes in operation of the Projects may affect riverbank erosion along the river.

TC Proposed Study #4: Hydraulic Modeling Study
Relevant NHDES Study Requests: 14a
NHDES Comments:

p. 43, Hydraulic Model Calibration and Verification. It is stated that calibration and verification will be based on a range of observed flows and water surface elevation from USGS gages and water level logger data. Figure 4-1 on p. 40 indicates that the model will be used to predict velocities which will be used in other studies. Considering the importance of velocity on erosion, aquatic habitat, etc., NHDES recommends that calibration of the model include comparison of predicted velocities at several cross sections to measured velocities.

p. 44. Sub-Hourly Flow and Elevation Rate-of-Change. It is stated that 5 modeling scenarios of 24 hours each will be run. The study plan should reflect that additional runs may be needed depending on the results and comments received from the reviewing agencies.

TC Proposed Study #5: Operations Modeling Study
Relevant NHDES Study Requests: 14a
NHDES Comments:

p. 49, Study Goals and Objectives. The study request submitted by NHDES requested that modeling be conducted to evaluate the potential effects of climate-altered flows on project operations over the course of the license. TransCanada's proposal does not address this objective, but should. Given studies such as those by researchers at the University of New Hampshire [1] that show that flood and drought frequency in New Hampshire has changed over the past 40 years, and is very likely to continue to change, climate change scenarios are necessary. Much of this type of modeling is already underway around the state, though not in the Connecticut River. NHDES requests that TransCanada address how they will evaluate the potential effects of climate-altered flows on project operations over the course of the license in their study plan.

p. 50, Methods. It is stated that a 5 year subset of the available 30 years of inflow were selected based on the annual and spring inflow volumes at Vernon and the annual energy production. The study should clarify if the rankings are based on 1 being the lowest or highest inflow volume or annual energy production. To better predict long term continuous impacts, it would be better to run all 30 years rather than a 5 year subset. It would seem that once the various relationships in the model are set up, it would not be difficult to run the model for all 30 years. Based on this understanding, NHDES requests that this be done.

p. 56. Sub-Hourly Model Consideration. Our interpretation of this section is that model runs assuming different project operation will only be run if the erosion, aquatic and terrestrial groups raise concerns based on model results assuming current project operations. One of the objectives in our study request was to compare hourly discharge and water surface elevations at various locations at current and proposed operating conditions to model results assuming instantaneous run-of-river at the Projects. Running the model assuming instantaneous run-of-river will help place bounds on the possible range of results and provide a relative idea of the sensitivity of the model. NHDES therefore requests that this scenario be run.

[1] Hayhoe, K., C. P. Wake, T. G. Huntington, L. Luo, M. D. Schwartz, J. Sheffield, E. Wood, B. Anderson and J. Bradbury. 2007. Past and future changes in climate and hydrological indicators in the US Northeast. *Climate Dynamics*, 28(4), 381 - 407

TC Proposed Study #6: Water Quality Monitoring Study
Relevant NHDES Study Requests: 22a, 22b, 22c; 25a, 25b, 25c.
NHDES Comments:

General: The information in this study includes some, but not all, of what is typically required in a sampling and analysis plan. DES requests that the Applicant submit a detailed sampling and analysis plan to NHDES for approval, that includes quality assurance provisions, to ensure the data will be useable for water quality standards attainment decisions.

p.62, Table 6-1 Summary of water quality station locations, 2014. This indicates that the most downstream datalogger (V-TR) is at RM 141.8 which is less than two tenths of mile downstream of the Vernon Dam. It is our understanding that TC (and/or FirstLight) will conduct water quality monitoring further downstream to the NH/MA border. Additional stations should be added to the study to ensure that more of the approximate 5.5 mile reach from the Vernon Dam to the NH/MA border is monitored.

p. 63, Figure 6-1. The plan showing the locations of the monitoring stations is illegible. A larger scale plan, as well as aerial photos of each sampling station (mainstem and tributaries) and the approximate water depth at each proposed sampling location should be provided with the sampling and analysis plan.

p. 64, Methods, 1st paragraph. It is stated that turbidity probes will be added to the mainstem Connecticut River multi-parameter datasondes. As stated in our study requests, placement of turbidity dataloggers should also be coordinated with other studies regarding erosion. For example dataloggers located closer to the river bank will be more likely to capture potential plumes associated with erosion. Dataloggers should be placed near shore just below the lower operating elevation of the projects and up and downstream of reference sites (i.e. sites with little potential for erosion) and sites with a higher potential for erosion. NHDES requests that this be addressed in the study. Data collected in this manner will help identify the impact of project operations on sediment movement/ erosion in the Connecticut River.

p.64, Methods. In order to compare results to NH surface water quality criteria for dissolved oxygen in impoundments, and as stated in our study requests (25a, 25b, 25c), "Dataloggers deployed in the impoundment should be set at the bottom of the epilimnion (if stratified) or at 25% depth if not stratified. A vertical dissolved oxygen and water temperature profile should be conducted at the time of deployment of dataloggers in the impounded section to determine if river is stratified and thus the appropriate depth for deployment." This should be included in the sampling and analysis plan.

p.67, Quality Assurance and Quality Control Procedures and Objectives.
The study does not specify the accuracy of all field monitoring equipment, or the laboratory methods and reporting limits for nitrate/nitrite, Kjeldahl nitrogen, total phosphorus and chlorophyll-a. This information should be included in the sampling and analysis plan.

p.68, Instrument Calibration and Frequency, 1st paragraph, 2nd sentence. This section indicates that the sondes at the continuous stations will only be checked halfway through the 10-day low flow period. This appears to contradict the second paragraph on p. 65 which states the continuous monitors will be maintained, calibrated and data downloaded on a weekly basis. All continuous monitors (not just those deployed for the 10-day low flow monitoring) should be maintained, calibrated, and data downloaded at a least every week. The study plan should be revised accordingly.

p 68, Instrument Calibration and Frequency, 1st paragraph, 1st sentence. This section states that calibration will be per the manufacturer's instructions. The calibration standards for dissolved oxygen (we calibrate to saturation and zero dissolved oxygen), pH, turbidity, specific conductance, and temperature should be included in the sampling and analysis plan.

p. 69, Analysis. It is stated that results will be compared to impoundment elevation. Results at all stations (not just the impoundment stations) should be compared to water surface elevation measured at or near each station. Also, the sampling and analysis plan should specify how flow in the bypass reach will be determined for the duration of the water quality study.

p. 70. Schedule. Monitoring is proposed for 2014. The study plan should reflect that if river flows in 2014 do not include representative low flow, high temperature conditions, additional monitoring will likely be necessary in 2015.

TC Proposed Study #8: Channel Morphology and Benthic Habitat Study
Relevant NHDES Study Requests: 8
NHDES Comments:

Please see comments submitted by the New Hampshire Fish and Game Department.

TC Proposed Study #9: Instream Flow Study
Relevant NHDES Study Requests: 5, 10
NHDES Comments:

General: Minimum flows are mentioned in several sections of this study. NHDES uses the term protective flows which may mean more than one protective flow at each Project. It should be made clear that the study will address the magnitude, frequency, duration, timing and rate of change of a range of flows when determining flows needed to provide suitable habitat for the selected target organisms.

p. 106. Study Reach, Study Site, and Transect Selection, last bullet. It is stated that preliminary river reaches include Vernon dam downstream approximately 1.5 miles. Please specify how was this distance was determined to be the riverine section downstream of the Vernon dam.

p. 108, Hydraulic Data Collection, 2nd paragraph, 1st sentence. It is stated that one complete set of depths and velocities will be taken at each transect at the target high flow or the flow level that can be effectively and safely measured. DES recommends that at a minimum another complete set of velocity and depth measurements be taken at or near the low range of agreed upon study flows so that the model can be properly calibrated. Also please specify the accuracy of the velocity meters.

p.110, Field Data Collection (2-D), 2nd paragraph, 2nd sentence. It is stated that single calibration flow with associated water surface elevations is required for a 2-D site, although additional flows and elevations can assist with model calibration. DES recommends that calibration be based on at least 2 sets of flow and water surface elevation that bracket the range of agreed upon study flows.

p. 105, Methods. As stated in our study requests 5 and 10, "Dataloggers should be deployed in each reach during the study to continuously monitor dissolved oxygen and temperature for comparison to State water quality standards." This should be addressed in the proposed study plan.

Please see other comments submitted by the New Hampshire Fish and Game Department.

TC Proposed Study #10: Fish Assemblage Study
Relevant NHDES Study Requests: 13

NHDES Comments:

Please see comments submitted by the New Hampshire Fish and Game Department.

TC Proposed Study #14: Resident Fish Spawning in Impoundments Study
Relevant NHDES Study Requests: 14, 16
NHDES Comments:

Please see comments submitted by the New Hampshire Fish and Game Department.

TC Proposed Study #15: Resident Fish Spawning in Riverine Sections Study
Relevant NHDES Study Requests: 12
NHDES Comments:

Please see comments submitted by the New Hampshire Fish and Game Department.

TC Proposed Study #16: Sea Lamprey Spawning Assessment
Relevant NHDES Study Requests: 19
NHDES Comments:

Please see comments submitted by the New Hampshire Fish and Game Department.

TC Proposed Study #17: Upstream Passage of Riverine Fish Species Assessment
Relevant NHDES Study Requests: 20
NHDES Comments:

Please see comments submitted by the New Hampshire Fish and Game Department.

TC Proposed Study #18: American Eel Upstream Passage Assessment
Relevant NHDES Study Requests: 24
NHDES Comments: Please see comments submitted by the New Hampshire Fish and Game Department.

TC Proposed Study #19: American Eel Downstream Passage Assessment
Relevant NHDES Study Requests: 9
NHDES Comments:

Please see comments submitted by the New Hampshire Fish and Game Department.

TC Proposed Study #20: American Eel Downstream Migration Timing Assessment
Relevant NHDES Study Requests: 3
NHDES Comments: Please see comments submitted by the New Hampshire Fish and Game Department.

TC Proposed Study #21: American Shad Telemetry Study - Vernon
Relevant NHDES Study Requests: 2, 4
NHDES Comments:

Please see comments submitted by the New Hampshire Fish and Game Department.

TC Proposed Study #22: Downstream Migration of Juvenile Shad Study - Vernon
Relevant NHDES Study Requests: 26

NHDES Comments:

Please see comments submitted by the New Hampshire Fish and Game Department.

TC Proposed Study #23: Fish Impingement, Entrainment and Survival Study
Relevant NHDES Study Requests: 18
NHDES Comments:

Please see comments submitted by the New Hampshire Fish and Game Department.

TC Proposed Study #24: Dwarf Wedgemussel and Co-Occurring Mussel Study
Relevant NHDES Study Requests: 12
NHDES Comments:

Please see comments submitted by the New Hampshire Fish and Game Department.

TC Proposed Study #27: Floodplain, Wetland, Riparian, and Littoral Habitats Study
Relevant NHDES Study Requests: 15a
NHDES Comments:

p. 260, Methods and p. 64, Deliverables. NHDES requests that the study plan 1) indicate use of field GPS units (with accuracy specified) for mapping, 2) that data will be uploaded and annotated in GIS so that plant species and their distribution are all georeferenced, and 3) that the shapefiles generated from the field work will be shared with resource agencies such as NHDES.

Please see comments submitted by the New Hampshire Fish and Game Department.

TC Proposed Study #29: Northeastern Bulrush Survey
Relevant NHDES Study Requests: 15a
NHDES Comments:

Please see comments submitted by the New Hampshire Fish and Game Department.

TC Proposed Study #30: Recreation Facility Inventory, Use & Needs Assessment
Relevant NHDES Study Requests: 1a, 1b, 1c
NHDES Comments:

Please see comments submitted by the New Hampshire Fish and Game Department.

<u>Comments on Study Requests that TC does not propose to conduct</u>

NHDES Study Request # 27: Climate Change and Continued Project Operations
NHDES Comments:

Please see comments for Study # 5 above.

NHDES Study Request #6, Shad Population Model for the Connecticut River
NHDES Comments:

Please see comments submitted by the New Hampshire Fish and Game Department.

New Hampshire
Fish and Game Department

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Glenn Normandeau
Executive Director

July 11, 2013

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E., Room 1A
Washington, DC 20426

RE: Final Review of the Draft Proposed Study Plans for FERC project numbers P-1904 (Vernon), P-1855 (Bellows Falls), P-1892 (Wilder), P-1889 (Turners Falls) and P-2485 (Northfield Mountain).

Dear Secretary Bose:

As the agency responsible for protecting fish and wildlife resources in New Hampshire, the New Hampshire Fish and Game Department (NHFGD) monitors and attempts to reduce the impacts of hydroelectric facilities on fish and wildlife species and their habitats. The mission of the New Hampshire Fish and Game Department (NHFGD) is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

The NHFGD submits the following attached recommendations and comments for final review of the Draft Proposed Study Plans (PSP) being developed for the Turners Falls (FERC No. 1899), Northfield Mountain(FERC No. 2485), Vernon (FERC No. 1904), Bellows Falls (FERC No. 1855), and Wilder (FERC No. 1892) projects.

Thank you for this opportunity to comment on this very important relicensing project. If you have any questions regarding these recommendations, please do not hesitate to contact either Fisheries Biologist, Matt Carpenter at 603-271-3511 or Gabe Gries at 603-352-9669.

Sincerely,

Glenn Normandeau
Executive Director

Comments and /or recommendations on TC Study Plans taking into account first draft of study plans (4/15/13), the TC study plan meeting notes and plan action items (from conference calls during late June), and the updated study plans on TC secure website (as of 7/5/13)

Study 6: Water Quality Monitoring and Continuous Temperature Monitoring

- Temperature should be monitored from April to November in order to gain a better understanding of potential project effects, especially with potential water temperature increases due to Vermont Yankee. Additionally, more temperature loggers should be placed above and below the Vermont Yankee discharge in order to differentiate between potential impacts of Vermont Yankee and TransCanada on water temperature and subsequently on the results of other studies that may be dependent on water temperature (for example, downstream migration of juvenile American shad).

Study 7: Aquatic Habitat Mapping

- The study plan talked about performing 1 foot contours along shorelines, but not in the main channel. They need to specify at what maximum depth they will record at 1 foot contours in order to account for shallow areas away from shorelines (i.e. humps, sunken islands, etc.). I believe we talked about areas less than 10 feet at the meeting. These shallow non-shoreline areas are very important areas for fish and are locations where depth and habitat may be more impacted by small changes in pool level.

Study 9: Instream Flow Study

- Delete yellow perch from species to be assessed as they do not require flowing water (per Rod Wentworth). Add sea lamprey (juvenile) and longnose dace to the list.

Study 10: Fish Assemblage Study

- Coefficient of variation should be reported along with mean relative abundance. Unless I read things wrong or missed something, they are describing just boat electrofishing during the day. Night is the preferred time for barge electrofishing, although it could be supplemented with minimal daytime shocking to see if any different species are captured.

- The 24 hour gill net set may cause excessive mortality. Field tests should be used to determine a set time that allows for efficient data collection while minimizing mortality. Perhaps start with 8 hour sets and increase/decrease set time as needed. If heavy mortality becomes an issue in a certain habitat type or time of day/night, then nets should be checked hourly.

- Another sampling method to consider is a seine net. A 30' bag seine may work well in shallow coves that cannot be accessed by a shock boat. A large beach seine may also work on open flats where the shock boat often scatters fish before they can be captured.

Study 11: American Eel Study

- Need to detail marking eels captured in eel pots as they did for those captured by electrofishing...

- The goal of the study is to collect baseline information on the eels in the mainstem, within project boundaries, so that future trends can be monitored. The actual abundance of eels potentially impacted by the projects could only be assessed by a watershed-wide survey, since eels may potentially inhabit all of the tributaries and lakes upstream of the projects. The extent of this potential habitat, which will not be surveyed, should be considered when evaluating the need for downstream eel passage.

Study 12: Tessellated Darter Survey

- There is some concern about potential fish mortality due to use of the electrified trawl.

Study 13: Tributary and Backwater Area Fish Access and Habitat Study

- Will perched culvert locations be documented? Tributary access should be examined year round as fish should be able move in and out of these backwater areas as needed.

- It is stated in study plan that "Additional water quality data will be collected in these areas (temperature, DO, ph, conductivity, and turbidity) if it is found that access to the main river is impeded." Water quality should be collected in these backwaters regardless of fish access. While fish may have access to a backwater, water quality may not be hospitable for fish if there is not a good exchange of water between the backwater and the mainstem.

- It is not clear how tributaries will be selected in the second year of study. It will be important to let the fish data inform the relative value of a tributary or cove, as opposed to the habitat data alone.

Study 14: Resident Fish Spawning in Impoundment Study

- The study focusses on spawning habitat where water depths at the lowest operation range are wetted to a depth less than one foot. This approach discounts areas that are wetted at the highest operation range and then subsequently dewatered. Yellow perch, for example, spawn in early spring among the branches of trees that fall into the water along the shoreline. These areas may be in relatively deep water, yet the eggs may still be exposed as the impoundment is drawn down. Fish behavior and spawning habitat type should take precedence over depth when choosing areas to monitor for the impacts of water level fluctuation.

- The actual impact of water level fluctuation goes beyond direct impacts to fish eggs and spawning behavior under current conditions. Water level fluctuation has a cumulative impact on fish habitat over time by preventing the establishment of aquatic plant communities and altering sediment deposition. The predicted distribution of aquatic vegetation and various substrate types in the impoundment under a more natural flow regime should be mapped to assess the long term effects of water level fluctuation on fish spawning habitat.

- It is not clear how impacts to spawning will be adequately assessed beyond the dewatering of known nest sites. Inaccessibility of spawning habitat and nest abandonment are important impacts that will be difficult to document without extensive field observation.

- The eastern silvery minnow should be included in this study as a species that depends on backwater coves for spawning.

Study 15: Resident Fish Spawning in Riverine Sections Study

- Examining project effects of scouring and sedimentation as it impacts nests would be prudent as scouring and sedimentation can impact egg survival.

- The longnose dace is a fluvial specialist that should be added to the list of target species.

Study 16: Sea Lamprey Spawning Assessment

- A sample size of 20 sea lamprey for radio tagging seems low.

- An assessment of sea lamprey spawning success should include a survey for sea lamprey ammocoetes. Sea lamprey ammocoetes may be easily captured by electrofishing as the electricity forces them out of the loose sediment in which they burrow. Sample sites should be selected just downstream from identified spawning areas. Data collected on each individual should include length, weight, and maturity (a certain percentage of individuals will have fully developed eyes and teeth in preparation for migration to the ocean). This survey should be done in late August or September when juvenile sea lamprey are approaching there maximum size for the year.

Study 18: American Eel Upstream Passage Assessment

- Any eels sampled should be marked (fin clip, elastomer?) in order to avoid data replication and also to possibly be able to make a population estimate.

- More could be learned by marking and releasing eels capture in eel traps than from relocating the eels upstream. This may allow for a population estimate or at least some basic movement data.

Study 19: American Eel Downstream Passage Assessment

- It should not be assumed that eel passage over spillways is high as all spillways are different and simply visually observing flow going over a spillway does in no way inform fish survival. Eel survival over spillways at all dams should be examined.

- All turbine types at each dam should be tested.

Study 20: American Eel Downstream Migration Timing Assessment

- In Study Goals and Objectives, third paragraph, add the following in red:

  There are few American eel upstream of the TransCanada projects in the mainstem Connecticut River, as indicated by annual electrofishing conducted in the lower portion of Vernon impoundment by Entergy Nuclear Vermont Yankee and as summarized in the Vernon PAD, and collections made by Yoder et al. (2009) above the Bellows Falls and Wilder dams.

  In Project Nexus, add the following in red:

  PROJECT NEXUS

  Currently the TransCanada projects have little, if any, direct effect on the overall outmigration of Connecticut River American eel because so few eels exist upstream of the TransCanada projects in the mainstem Connecticut River.

- Under Project Nexus, there is the following statement: "Currently the TransCanada projects have little, if any, direct effect on the overall outmigration of Connecticut River American eel because so few eels exist upstream of the TransCanada projects." This statement should be removed for a number of reasons. For one, we do not know how many eels exist upstream of the TransCanada projects. Secondly, if there are less eels, one could interpret this as meaning TransCanada could have more of an impact on their population.

- There is disagreement with the logic that there are not enough eels to do anything but a literature review. We have no idea how many eels may be in the lakes and ponds upstream of the projects. I think that fyke nets or some other traps should be set at the mouth of the tributaries or any pinch point where eels may be captured. This would tell us as much, or more, than the eel survey about the number of eels upstream of the projects. Any eels captured would be better candidates for telemetry studies than the eels captured downstream at Holyoke. There are eels in Lake Winnipesauke, which has a total of 9 dams downstream.

Study 21: American Shad Telemetry Study – Vernon

- A sample of fish from the early, middle and late part of the run should be tagged. All tags should have "mortality add-ons" and sample sizes of tagged fish should be as high as budget allows. Fish should be tagged below Turners Falls and allowed to proceed upstream "naturally" so that fish examined at Vernon have the typical experience/history of shad that would normally be in that stretch of the river. In the study plan, only manual tracking above Vermont Yankee is proposed, but that will not help determine if Bellows Falls operations are influencing fish migration, etc… Stationary receivers need to be deployed between Vermont Yankee and Bellows Falls.

Study 22: Downstream Migration of Juvenile American Shad – Vernon

- The applicant does not want to do a turbine mortality study on the Francis turbines (units 1-4) because a previous study found only 10% of Atlantic salmon smolts passed through these units and that project mortality by this route will be minimal. We cannot assume that juvenile shad will take the same routes as smolts. They should use the 2014 route selection study to see if their above assumptions are true in terms of route selection and if their assumptions are false, they should do a turbine mortality study on Units 1-4 in 2015.

- It will be best if study fish are collected above the Vernon Dam so that difference in migration timing between up and downstream fish do not bias results.

- Hydroacoustics was ruled out due, in part, to the noise and turbulence around the dam. A hydroacoustic transducer oriented across the water column at location far enough upstream of the dam to minimize interference would provide important data on the total number of juvenile shad moving into the project. This would increase the value of the video monitoring data collected at the bypass by providing a better estimate of the number of fish that use the bypass as a percentage of the total number of fish that migrated into the project area.

- Care should be taken in interpreting the results in relation to any impacts Vermont Yankee's thermal discharge may be having on juvenile shad route selection, timing and migration rates. As such, additional temperature loggers in this general area would be useful (see comments on Study 6).

- There are concerns about the 110 mm minimum size and the 8 day tag life. A size bias in the data may down play the role of predation and possibly over-estimate the turbine mortality. With a short tag life, you run the risk of tagging fish that are not actively migrating. It may be difficult to find an adequate number of large individuals for tagging. That said, wild fish should be preferred over hatchery fish, which may behave differently than wild fish collected from the river.

Study 23: Fish Impingement, Entrainment, and Survival Study

- This is just a desktop exercise and no field work is proposed. The study is supposed to "help establish a baseline condition to assist in evaluating the number of fish entrained or impinged and the expected survival of those fish at each of the projects." Without knowing actual numbers impinged or entrained, it is impossible to calculate the above.

- Baseline data on entrainment rates are site specific and should not be calculated by using data from studies at other dams and assuming things are the same.

Study 30: Recreation Facility Inventory, Use and Needs Assessment

- Survey should cover all seasons as the public uses the river and its recreation facilities throughout the year. Study plan should include the following: 1) provide a maintenance schedule for the upcoming license period for all TransCanada recreation sites, 2). Add another question to on site interviews that ask if impoundment fluctuations have **ever** impacted their recreation (not just if fluctuations impacted their recreation on day of interview.

New Hampshire
Fish and Game Department

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Glenn Normandeau
Executive Director

July 15, 2013

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E., Room 1A
Washington, DC 20426

RE: Additional Information for Final Review of the Draft Proposed Study Plans for FERC project numbers P-1904 (Vernon), P-1855 (Bellows Falls), and P-1892 (Wilder) relative to Non-Game Insect Species studies.

Dear Secretary Bose:

As the agency responsible for protecting fish and wildlife resources in New Hampshire, the New Hampshire Fish and Game Department (NHFGD) monitors and attempts to reduce the impacts of hydroelectric facilities on fish and wildlife species and their habitats. The mission of the New Hampshire Fish and Game Department (NHFGD) is to conserve, manage and protect the state's fish, wildlife and marine resources and their habitats, and to provide the public with opportunities to use and appreciate these resources.

The NHFGD submits the following attached recommendations and comments for final review of the Draft Proposed Study Plans (PSP) being developed for the Vernon (FERC No. 1904), Bellows Falls (FERC No. 1855), and Wilder (FERC No. 1892) projects. These are additional comments and recommendations that were not included in recent submissions involving fisheries issues. These comments are exclusively to the study protocols involving Non-game insect species.

Thank you for this opportunity to comment on this very important relicensing project. If you have any questions regarding these recommendations, please do not hesitate to contact either Wildlife Biologist, Emily Preston at 603-271-2461.

Sincerely,

Glenn Normandeau
Executive Director

Comments on FERC Relicensing study protocols:

COBBLESTONE AND PURITAN TIGER BEETLE SURVEY
The Puritan Tiger Beetle is also listed as endangered in NH. This should be noted and the permit request to NHFG should include that species. The goals listed from the VT Wildlife Action Plan are similar to that in the NH Wildlife Action Plan. The study area should include Johnson, Burnaps, Chase and Walpole Islands as well as any identified during their habitat assessment.

DRAGONFLY AND DAMSELFLY INVENTORY AND ASSESSMENT

Given the rarity of the focal species that really should be considered SGCN, (Gomphus quadricolor and Gomphus ventricosus) I'm not sure the proposed methods will be that productive in getting a better feel for their distribution and behavior - and thus inform conservation actions. Because emerging riverine Odonata can be highly variable in space and time, the proposed sampling scheme is not likely fully capture the broader patterns, especially for rare species. By sampling only three times over the summer, it is quite possible to completely miss the peak emergence events for some species, thus limiting the amount of data that can be collected. Similarly, random survey transects perpendicular to the shore will easily miss clusters of exuviae/emerging adults that could be only a few meters away. In combination with a reduced temporal sample, there is a reasonable chance that no exuviae of some focal species would be found at a given site on a given visit, depending on the number of transects (which is not stated in the proposal). A better approach would likely be a survey plot covering several meters of shoreline, and still extending up the bank so as to measure emergence distances. I believe this is the method used by Morrison and colleagues during their studies on the river in Massachusetts.

The other species listed by VT as being SCGN are not considered so in NH due to the results of the NH Dragonfly Survey. We can supply the application with the report of that Survey and some of the data if they would like it.

The Nature Conservancy
Protecting nature. Preserving life.™

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July 15, 2013

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

Subject: Wilder Hydroelectric Project, FERC Project No. 1892
Bellows Falls Hydroelectric Project, FERC Project No. 1855
Vernon Hydroelectric Project, FERC Project No. 1904
Comments on Proposed Study Plan

Dear Secretary Bose:

Pursuant to the Federal Energy Regulatory Commission's (Commission or FERC) regulations 18 C.F.R. § 5.12, The Nature Conservancy (TNC) is providing comment on TransCanada Hydro Northeast Inc.'s (TransCanada) Proposed Study Plan (PSP) for the relicensing of the Wilder (FERC No. 1982), Bellows Falls (FERC No. 1855), and Vernon (FERC No. 1904) Hydroelectric Projects, filed on April 15, 2013, and the Updated Proposed Study Plan, filed by TransCanada on July 8, 2013. Unless specifically noted, all comments in this letter are in reference to the July 8, 2013 Updated PSP.

Between May 13, 2013 and June 21, 2013, representatives of TNC's Connecticut River Program attended several meetings and conference calls held by TransCanada to discuss the content and further development of the PSP. Overall, we find that the concerns and comments that we raised at these meetings were addressed in the Updated PSP; however, there are some remaining study components that we find require clarification and further refinement. Our comments below address these concerns, and are based on a review of the April 15, 2013 original PSP, the July 8, 2013 Updated PSP, and discussions that took place at meetings held between May 13 and June 21, 2013.

The comments that follow are organized by the numbering and study titles given in the July 8, 2013 Updated PSP.

Updated Study 4: Hydraulic Modeling Study

Deliverables

On page 47, TransCanada presents a brief description of the report that will be prepared for the hydraulic study. We request that the following specific components be included in the report or provided upon request:

- The HEC-RAS files necessary to run the models and reproduce the results, including the geometry files, plan files, flow files, and project files (i.e., file extensions .f, .g, .O, .p, .prj, and .r);
- The associated GIS files with topographic data for the valley and stream cross sections; and
- A brief summary of the approach taken to calibrate the model including the data used and assumptions made.

Updated Study 5: Operations Modeling Study

Methods

On p. 53, TransCanada states that each year of the 5-year subset used for model inflows corresponds to a particular ranking of annual flow volume at Vernon and to a particular ranking of annual system energy production. We request that TransCanada please clarify whether these rankings are ascending or descending. In other words, does a ranking of 30 correspond to the largest value of annual inflow or energy production, or to the lowest value? In addition, it is not clear how the ratio of spring total inflow to annual inflow volume is different among the five years. If the selection was based on both annual and spring total inflow volumes at Vernon, and represents different seasonal patterns as well as a range of overall hydrology inflow, it would be helpful to know the rank of each year relative to spring total inflow volumes as well.

Additionally, we request that TransCanada please explain or clarify how the operational impact of subsequent wet or dry years will be evaluated if only one year is run through the model at a time.

On p. 54, TransCanada provides some explanation of the rationale and methods for defining hourly market energy prices. The text states, "…the 2010 hourly prices were filtered by deriving the average hourly weekday and weekend prices for each month for use in the model." Does this mean that there are only two derived values associated with each month: a weekday value and a weekend value? We request that additional detail be provided to clarify the filtering process, perhaps by including the steps used to develop the energy price signals.

Updated Study 9: Instream Flow Study

Deliverables

We request that TransCanada please make the raw data available so that agency representatives and other interested parties may conduct additional analyses beyond what is done within the scope of this study.

Updated Study 10: Fish Assemblage Study

Project Nexus

On page 116, TransCanada states, “This study…will represent the available habitat within project operational ranges for resident and diadromous fish populations.” Because this is not a habitat study, it is not clear how this study will represent available habitat; however, an assessment of available habitat could potentially be made with additional data from the Aquatic Habitat Mapping Study (Study 7) and the Instream Flow Study (Study 9). Furthermore, it is not clear within the methodology how this study will “allow for the contribution of both factors (project operations and available habitat) to the baseline fisheries conditions to be examined for limiting and non-limiting influences” (p. 117). This claim itself is unclear, as well as the methods for its achievement.

Study Area and Study Sites

For the Bellows Falls bypassed reach, we do not recommend changing the size of the sample segment (from 500 m to 100 m) simply because the length of the defined sampling reach is less than that of the other strata, as suggested on page 117. This will cause unnecessary bias in the collected data, such that if there are any differences in assemblage structure at this site, it will be impossible to differentiate actual site effects from sampling bias error. Normalizing the sample by effort may also be ineffective because the relationship between catch and effort is not necessarily linear. Sampling a 100 m segment in a smaller reach implies that a 100 m sample is equivalent to a 500 m sample after normalization. If this were the case, then sampling a 500 m segment would unnecessarily multiply sampling effort at any site. Therefore, either too much sampling is being done at most sites or 100 m is not a sufficient length for a sample. In either case, the methods at present require modification. It is imperative that sampling effort is as equivalent as possible among all sites within all strata. The solution to the problem of strata of greatly disproportionate lengths is either to make all sample segments shorter so that an adequate number of sites can be sampled in each stratum, or simply to sample fewer sites in the shorter reaches, with at least three sample segments in each stratum.

Methods

If the issue of collecting a smaller sample in the Bellows Falls bypassed reach is not simply a matter of the length of the stratum, but is an issue associated with gear type, sampling smaller reaches in this one stratum is still not an acceptable solution for reasons similar to those described above. Substantial bias will result if the Bellows Falls bypassed reach is the only stratum that is sampled with pram or backpack electrofishing. Gear bias is the tendency of gear, including different electrofishing methodologies, to select for some species and sizes of fish more than others. If there are any differences within the Bellows Falls bypassed reach data set compared to other sites, it will be impossible to differentiate gear bias error from any actual site effects. In order to accurately characterize the fish assemblage of the project area, sampling methods must be consistent throughout the entire study area.

Because different gear types have different efficiencies in various habitat types, it may be effective to stratify sampling by habitat type. If backpack/pram electrofishing is the only effective method for sampling the Bellows Falls bypassed reach, then this is a valuable method that should be used in other sections of the study area (e.g., in shallow riffles and runs). The Aquatic Habitat Mapping Study (Study 7) could potentially assist in identifying different habitat types. We suggest that once Study 7 is completed, the results should be used to inform site and/or gear selection for this study. We recommend that sites be chosen randomly, but proportionally by habitat type. At each site, at least three replicates of each habitat-specific gear type should be sampled. This prevents bias from anomalous samples, allows for site-level statistical evaluation, and is standard scientific field design (Eberhardt and Thomas 1991, Krebs 1998). Alternately, one sample each of three different habitat-specific gear types could be considered independent replicates. This kind of robust, stratified random sampling design is especially important if the collected data are to be “examined for limiting and non-limiting influences,” as suggested in the Nexus (p. 117). Without replicates it is difficult if not impossible to draw conclusions from the data; this is basic statistical and scientific methodology (Eberhardt and Thomas 1991, Krebs 1998).

Analysis

On page 121, TransCanada states that “Summary statistics will be calculated by stratum and sampling technique…” If summary statistics are to be calculated by sampling technique, then the premise is that values of different strata and sampling techniques can be compared. In order for this to be true, the collection of samples within each stratum and by each sampling technique needs to follow a similar sampling design (e.g., stratified random, as described briefly above). Otherwise, it is not possible to compare strata or sampling techniques and draw inference concerning differences or similarities among them. Sampling methodologies should be used consistently, and never simply as a substitution in areas where habitat makes sampling difficult. Catches among gear types can only be compared if they have been sampled with the same basic design, and if they are intended to sample the same habitat.

Deliverables

We request that TransCanada please make the raw data from this study available in digital format so that agency representatives and other interested parties may conduct additional analyses beyond what is done within the scope of this study.

Schedule

Because the development of field study design is critical to the ability to use study results, we strongly support and value the included allowance provided in the schedule (p. 122) to share the sampling locations with the aquatics working group for consultation and approval.

Updated Study 12: Tessellated Darter Survey

Study Area and Study Sites

We recommend adding one more sampling segment to the reach below Vernon. Doing so will allow for greater statistical inference. If adding one more site is unacceptable in terms of study costs, we suggest re-evaluating the distribution of effort elsewhere, sampling proportionally by length of the reach, but with a minimum of three sites in each stratum. Alternately, the size of the individual samples could be changed in order to keep costs equivalent.

Methods

The recommendations provided for the Fish Assemblage Study (Study 10) with regard to sampling design apply to this study as well. Sampling methodologies should be used consistently, and never simply as a substitution in areas where habitat makes sampling difficult. Sampling methods cannot be determined on a case-by-case basis as implied (p. 134). This causes bias in the collected data, and makes it difficult if not impossible to distinguish differences in population size and structure at a site from error due to gear bias. Therefore, we strongly suggest that methods be used consistently across habitat types. The Aquatic Habitat Mapping Study

(Study 7) should be useful for determining various habitat types and the gear that will be required to sample them. If only one method is being used, sites should be randomly selected from those sites that may be effectively sampled by that particular gear type. Ideally, replicate samples should be taken at a site (e.g., three 2-minute tows per 500 m reach instead of one 5-minute tow). This prevents bias from anomalous samples, allows for site-level statistical evaluation, and is standard scientific field design (Eberhardt and Thomas 1991, Krebs 1998). Alternately, three samples of different sampling gear types could achieve a similar result.

We advise extreme caution when using information on dwarf wedgemussel (DWM) distribution to inform sample station placement. Details in the methods suggested that sites would be placed both to avoid DWM (p. 135) and to ensure that sampling occurs within the DWM distribution (p. 133-134, "Study Area and Study Sites"). However, care should be taken that this directed placement does not bias results toward artificially positive association (if adding sites near DWM populations) or artificially negative association (by avoiding sites near DWM populations). We recommend that a gear type is selected that is acceptable to use in areas where DWM are present, and that this gear type is used consistently across the entire study area. To ensure that samples are collected in areas where DWM are present, DWM distribution data can be used to define the spatial extent of sampling strata. However, samples must still be randomly selected within strata to prevent bias in the data, which would severely limit the ability to draw conclusions from the results. The objective of this study is to characterize the distribution and relative abundance of tessellated darter (p. 130), with an aim to relate this distribution and abundance to that of DWM. Whereas it is not necessary to sample exactly where DWM occur, it is imperative to ensure the spatial design of the sampling protocol is sufficient to meet this objective.

Because the development of field study design is critical to the ability to use study results, we strongly support and value the included allowance provided to consult with the aquatics working group "to determine the most appropriate sampling gears and placement of sampling locations to both minimize potential disturbance of DWM while maintaining a defensible and scientifically sound sampling procedure."

Deliverables

We request that TransCanada please make the raw data from this study available in digital format so that agency representatives and other interested parties may conduct additional analyses beyond what is done within the scope of this study.

Study 24: Dwarf Wedgemussel and Co-Occurring Mussel Study

Study Goals and Objectives

Throughout this study, there is reference made to collaboration with resource agencies with regard to study design and implementation. We hope that this collaboration can include other members of the aquatics working group that have experience and expertise in study design and interest in the long-term success and persistence of dwarf wedgemussel (DWM) populations. The Nature Conservancy is certainly interested in the development of this study, and would like to be included if possible.

Deliverables

We request that a version of the results and report be made available that has sensitive information redacted. Currently, the language states that all of the results from Tasks 2 and the pilot study will be confidential. However, shell condition, abundance of uncommon species, habitat variables, observed behavioral response, and other valuable information will be provided in these reports. This information is important for understanding project effects, and should be made available apart from sensitive locality data.

Thank you for this opportunity to provide comment on TransCanada's Proposed Study Plan. If you have any questions regarding the preceding comments, please contact Katie Kennedy at the Nature Conservancy's Connecticut River Program office (413-586-2349 or kkennedy@tnc.org).

Sincerely,

Kim Lutz

Kimberly A. Lutz
Director, Connecticut River Program
The Nature Conservancy

Kathryn D. Mickett Kennedy

Kathryn D. Mickett Kennedy
Applied River Scientist
Connecticut River Program
The Nature Conservancy

Literature Cited

Eberhardt, L.L., and J. M. Thomas. 1991. Designing environmental field studies. Ecological Monographs 61:53-73.

Krebs, C.J. 1998. Ecological methodlogy, 2nd edition. Benjamin Cummings, Menlo Park, California.

The Nolumbeka Project Inc.
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July 10, 2013

Ken Hogan, Project Supervisor
Federal Energy Regulatory Commission
Office of Energy Projects
Division of Hydropower Licensing
Washington, DC 20426

RE: Wilder Dam Project No. 1855-026
Bellows Falls Project No. 1855-045
Vernon Project No. 1904-073
Turners Falls Project No. 1889-081
Northfield Pump Storage Project No. 2485-063

Dear Mr. Hogan,

The Noulmbeka Project wishes at this time to respond to the proposed study plans as offered by Trans Canada and First Light.

We will start with First Light's response to our study request 1. We asked for a comprehensive investigation and mapping of the of the ancient trail systems and fishing stations and other special places that exist on the river's edge and up on the Wissatinnewag village site proper.

First Light's response suggests that archaeological surveys will result in reports that will discuss cultural landscape as a result of the surveys, but they indicate they will not be looking at steep grades and wetlands, they also indicated they will not do TCP study. The Nolumbeka project will be requesting a TCP study. That request will be filed with this letter.

Our request was clearly asking for studies of the built earthworks and trail systems that were created many thousands of years ago on the Wissatinnewag Village Site out of the need to access some of the most productive fishing in the river on what is now called the Bypass Reach. The Bypass Reach area abuts the Wissatinnewag Village site. This terrain is a steep rock ledge that goes right down to the ancient waters edge. These built trail systems were not simply ruts worn in the earth by thousands of years of use, but were engineered roadways that required the builders to cut into the upper ledge materials and redeposit that material down grade to create a safe traversing trail system to access fishing earthworks ledges on the ancient Lake Hitchcock shoreline and later down to the river. They included fishing, ceremonial sighting, and canoe-launching stations.

First light indicated that Nolumbeka offered no nexus or direct link to the project area in our study requests. Nolumbeka feels strongly about the fact that the Wissatinnewag Village site existed 12,000 years before colonial boundaries and lines were ever drawn on a map. First light offered up on their project boundaries map a lined off area showing the Wissatinnewag Village property. The village is a congruent and fully connected cultural resource that goes right to the water's edge, and in this area has not been degraded or impacted by modern progress with the exception of the damming of the river in the last hundred years, and the loss of the natural water flow rates. This cultural resource is a rare jewel. We would also like to point out that we created the conservation easement that abuts First Light's land on the rivers edge. Nolumbeka has a legal agreement with U.S. Fish and Wildlife in our conservation easement partnership that articulates our shared stewardship for the protection of the Wissatinnewag property. In this contract we share responsibility for the safeguarding of the cultural resources that connect with First Light's property, and we use that section of the Wissatinnewag village for educational programs that promote the protection of Native American cultural resources and a Native viewpoint of the history of the region. We feel we have a stronger than average connection or nexus to the river resource area and First Lights operations impact nexus.

First light and trans Canada would like to eliminate steep slopes and or swamps or wetlands from study consideration. This request by the Licensee's is exactly why we recommended the need for more culturally sensitive and better-trained researchers. To address wetlands, Nolumbeka feels there needs to be an educational component that might help First Light, Trans Canada and FERC understand how important to Native cultural values wetlands have always been. Wetlands have been for thousands of years one of the most powerful gathering places for healing resources and ceremony, as well as foraging and are very often associated with ceremonial stone landscapes. To disregard the need to look more closely at wetlands is to marginalize a culture's ceremonial connection to the land, their history and values. Many important archaeological discoveries have been located in what were considered wetland areas. Nolumbeka would like to request that steep slopes and wetlands be included in the cultural studies, inventory and project boundaries discussions. If the Licensee's choose not to look at steep slopes and wetlands they will not have a complete inventory of the cultural resources in their project areas.

Nolumbeka also requests to be a part of the on the ground field studies and data analysis component of this project licensing process. Since 1997 we have been doing research, data analysis and field monitoring of archaeological sites and have worked closely with the Narragansett (NITHPO). We have created a digitized historic cultural database and have worked with a number of tribes including the Narragansett (NITHIPO) to assist in their cultural and historical research when the tribes have been working to protect their cultural resources on project impacted lands. The Nolumbeka Project has been one of the early organizations involved with the discoveries of a number ceremonial stone landscapes. We have offered to continue our work with the Narragansett Tribe to create a centralized database in the Gill Turners Falls area to streamline and make study reports and oral histories more accessible to the tribes when projects impacts might need to be taken into consideration in the river boundaries area.

We are aware that a number of archaeological 1A studies have been done without tribal partnership. Trans Canada has requested the right to recycle an archaeological 1A study created five years ago under an old licensing issue without tribal participation or monitoring. We feel that is not the way to build trust with the tribes or the public and seem to not be congruent with the spirit of the 106 processes. Nolumbeka pointed out in our first letter to FERC that we felt it was important to bring on board professionals trained by the tribes to recognize the life ways and sacred practices and spaces of the indigenous peoples of this river valley culture. The Nolumbeka Project sees the recycling of Trans Canada's 5-year-old archaeological 1A study as a short cut that undermines the 106 processes.

In 2.1.6 Cultural Resources FERC def # 6 FERC requested First light to provide available information of Indian Traditional Cultural and Religious Properties as specified in 5.6 (d) (3) (x) (B), and 5.6 (d) (3) (x) (C).

First Light replied, "There are no known Indian traditional cultural properties (TCPs) or religious properties within the Turners Falls Project and Northfield Mountain Project boundaries". First light acknowledged The Turners Falls Sacred Ceremonial Hill Site, but claimed that it was not located in either of the projects boundaries.

Nolumbeka would like to respond that the Turners Falls Sacred Ceremonial Hill Site is not just a hill at the Turners Falls Airport, but is as a district that covers a 20-mile radius. This district covers a great deal of First Light's Project boundaries. Also some of the stone structures located on the Wissatinnewag Village property are a component of the Ceremonial Hill and have a direct line of vision and contextual connection to that location.

There is an Indian village currently underwater in Barton Cove, and in First Light's APE. Prior to the raising of the water level for the hydro production, that piece of land was pastureland and well before it was a pasture it was a part of the Great Falls village that was attacked by William Turner in the early dawn raid at the Great Falls on May 19, 1676. This site is by its very nature a traditional cultural property and also a religious property. Under water in that area are some of the cultural artifacts of that village and the attack, which includes a number of muskets that were being repaired at the village at that time as well as the forge and at least 2 pigs of lead. It can be expected that the personal artifacts of some of the victims could well be under water in that locus as well.

Just south of the By-Pass Reach area there are shell middens on the north end of the islands that were deposited over thousands of years during the warmer months when the prevailing winds are out of the south. Nolumbeka would like to see studies of these middens. We feel they could reveal significant new information on the sturgeon and shellfish habitat in the By-Pass Reach area and the river in general. It is also common for cultural discarded artifacts to be located in the disposal sites such as midden areas. These are well within First Light's APE. Nolumbeka feels First light's operations have had an impact on the cultural resources within their APE with erosion most especially but not limited to the area in and around the islands and on the shell midden sites as well as directly across form the Northfield Mountain Project and at many points down river including the Kells Farm Paleo Indian Site.

Nolumbeka would like to respond to 2.2.2 Cultural Resources (FERC AIR #2)

FERC requested First Light to include in your study proposal that you would also consult with the Vermont, Massachusetts, and New Hampshire SHIPO'S and any involved Indian Tribe or other interested parties in formulating each of the tasks.

First light has not consulted with any Indian tribe that we know of, nor have they consulted with The Nolumbeka Project in formulating what the projects APE will look like. We have yet to see any research data for review on the known cultural resources in the project boundaries. It appears to us that First Light will create the APE with only SHIPO review and has not brought in the Tribes and other interested parties including Nolumbeka. We would like to have the chance, in a timely manner, to review and respond to the data that will be used to set the projects APE.

Nolumbeka feels First light misunderstood the study request from a number of other interested parties including Nolumbeka and the Town of Montague regarding the Great Falls Native Cultural Park. The study requests for the Great Falls Native Cultural Park was a request to study what it would look like for the Licensee's to help create the Great Falls Native Cultural Park as a way to give back to the Native American community and the general public something of cultural value that would help create historic tourism as a form of recreation and education in this area. This would go a long way to make up for the cultural resources that have been compromised on the river over the years during the development of Hydro Power. These Native American cultural resources were not addressed during the last licensing process many years ago. Nolumbeka has documented a number of cultural resources that have been damaged, destroyed and or lost and have on a number of occasions slipped by First Light's accountability to those resources over the years. The Great Falls Native Cultural Park would also allow for a more balanced Native historical viewpoint on the Great Falls massacre of May 19,1676. This story is a powerful piece of history that needs to be told from a Native perspective. Nolumbeka feels that the story told from that perspective would contribute to the Recreational Historic Tourism in our area. A number of years ago a study was done to get a sense of what percentage of sites listed on the National Register of Historic Places are Native American sites compared to other cultural groups. In Massachusetts out of the 3,602 sites listed only 1 out of 300 sites were Native American. That is 0.33% of the sites listed. In Maine out of 1,295 sites listed there were 102 Native sites. That is 1 out of 12.7 sites listed as Native American. The Great Falls Native Cultural Park is a chance to shift the trend that has led to such low numbers of Indian sites listed on the National Register of Historic Places that has prevailed here in Massachusetts for over 40 years. The Great Falls Native Cultural Park would expand a form of recreation that is catching on all over the world, Recreational Historic Tourism. Right here in the Great Falls area, the State Massachusetts has the history of a fascinating 12,000-year-old Indigenous culture that could be taped into as part of Recreational Historic Tourism. This is a form of recreation that has been overlooked for too many years. Nolumbeka strongly supports a study by the Licensee's to create a Native Cultural Park in the Montague Gill area.

2.3.3 Cultural Resources (FERC AIR 37)

In addition to the FERC, Massachusetts, Vermont and New Hampshire recommendation to do a Phase 1A Archaeological Survey and Historic Structure Survey, Nolumbeka requests that FERC consider requiring that survey to include Native American built stone structures, earthworks and ceremonial stone built landscapes in the APE as is the case in other states like Ohio, and if physically connected to go beyond the APE. Nolumbeka finds the APE maps we currently have to view, offer very little insight on what exactly is out there for cultural resources. Without the ability to review any studies that have been done, we find there is no way for us or the tribes to participate on the assessment of the applicability of the suggested APE Boundaries. Nolumbeka would like to review the research and compare it with what we know to exist in our archives before we would feel we have been allowed to be a contributor in this process. We have been doing this type of research work for the tribes since 1997, and we understand the process well enough to lend additional viewpoints and conversation to the decision making process in formulating each of the tasks.

3.4 Terrestrial Wildlife and Botanical Resources

3.4.1 Baseline Study of Terrestrial Wildlife and Botanical Resources at the Turners Falls Impoundment, the Bypass Reach and below Cabot Station within the Project Boundary

The Nolumbeka Project feels that our first request to do terrestrial wildlife and botanical resources studies on the Wissatinnewag property are congruent with 3.4.1 and would add to the body of knowledge that the Recreational Historic Tourism public would appreciate in their forays to the Turners Falls Gill- Greenfield historic site visits. Nolumbeka would like to take part in this process and would be happy to assist researchers on and around the Wissatinnewag Village Site.

3.6

3.6.1 Recreation Use/User Contact Survey

The Nolumbeka Project considers ourselves to be a unique stakeholder group do to the fact that we own a 41 acre 12,000 year old village site conservation easement in partnership with US Fish and Wildlife's 21 acre portion of the combined 63 acre Wissatinnewag Historical Village Site proposed to be a part of a Recreational Historic Tourism Plan for the Towns of Gill, Turners Falls and Greenfield. Our knowledge of the Bypass Reach is augmented by our access to that part of the river through our land and our mission as a cultural preservation nonprofit. We feel we could be of use to help assess possible access points in the Bypass Reach part of the river and possible canoe portage trails that might be feasible.

3.6.5

The Nolumbeka Project considers our use of the land in the project area in harmony with the cultural history and attraction to the Great Falls area, and we request to be identified as such in the goals and objectives in consideration in 3.6.5

The Nolumbeka Project Study Request 4

As part of our study request 4, Nolumbeka and the Narragansett (THPO) asked for a study to create a centralized housing facility in the Gill Turners Falls area for our archives and study programs, as well as a centralized housing facility to digitized and disseminate to approiate tribes and researchers, the total of documents that have been amassed over the years on cultural studies done up and down the Connecticut River and in the surrounding area. The public perception at this time is that if just such a facility were in place now the current licensing process would be much streamlined as there would be no disconnect with what is out there and where it is and how it might impact any of the Licensee’s projects on the river and beyond. There will be a need for just such a facility many times over the next 30 to 40 years of this license issue, and the Nolumbeka Project would be happy to team up with any of the tribes, the SHIPOs and the Licensees to create the protocols and institute such a program. Right now the cultural data that is out there is still in the early twentieth century mindset and access. This condition makes it difficult for a transparent exchange of data and research needed by the tribes and other interested parties to facilitate a balanced decision making process on the proposed Licenses for First Light and Trans Canada or any future projects that might need cultural impact consideration. The Nolumbeka Project feels our request could play an important part of creating a new attitude around Native American cultural preservation efforts here in the Connecticut River Valley and beyond and we strongly encourage FERC to support just such an endeavor.

Thank you,

Joseph Graveline, President
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July 14, 2013

Ken Hogan, Project Supervisor
Federal Energy Regulatory Commission
Office of Energy Projects
Division of Hydropower Licensing
Washington, DC 20426

RE: Wilder Dam Project No. 1855-026
Bellows Falls Project No. 1855-045
Vernon Project No. 1904-073
Turners Falls Project No. 1889-081
Northfield Pump Storage Project No. 2485-063

Dear Mr. Hogan,

The Nolumbeka Project Inc. would like to request a Traditional Cultural Properties Study for the above listed projects.

Study Request. Traditional Cultural Properties Study

During the June 12, 2013 study plan meeting discussing proposed study plan (PSP) studies 3.7.1 Phase 1A Archaeological Survey and 3.7.2 Reconnaissance-Level Historic Structures Survey, our group raised the question about whether a sacred ceremonial landscape would be considered a "structure" in the Historical Structures Survey. The answer was that these are typically covered in a Traditional Cultural Properties (TCPs) Study Plan, which is not currently in the PSP. We are therefore submitting a request for one.

TCPs are locations associated with cultural practices of beliefs of a living community that are: 1) rooted in that community's history: or 2) important in maintaining the continuing cultural identity of a community. (National Register Bulletin 38, 1998:1). Parker and King (1998) defines a TCP as:

- Locations associated with traditional beliefs of an aboriginal/indigenous group about its origins, its cultural history, or the nature of the world and cultural landscapes.
- A rural community whose organization, buildings and structures, or patterns of land use reflect the cultural traditions valued by its long-term residents.
- An urban neighborhood that is the traditional home foe a particular cultural group, and that reflects its beliefs and practices.
- Locations where Native American religious practitioners have historically gone and are known or thought to go today, to perform ceremonial cultural rules of practice.
- Locations where a community has traditionally carried out economic, artistic or other cultural practices important in maintaining its historic identity.

Goals and Objectives

The goal of the study is to assist the Federal Energy Regulatory Commission (FERC) in meeting its compliance requirements under Section 106 of the National Historic Preservation Act (NHPA), as amended, by determining if licensing the Project will have an adverse effect on National Register of Historic Places (NRHP)-eligible TCPs, ethnographic resources, or other cultural resources of tribal significance.

The objective of this study is to identify TCPs and other cultural resources of tribal importance that may potentially be affected by Project operations, evaluate their eligibility to the NRHP, and identify Project-related activities that may affect TCPs, other tribal interests, or traditional interests of other groups within the Area of Potential Effect (APE).

Relevant Resource Management Goals

The Nolumbeka Project in cooperation with the Narragansett Indian Tribal Historic Office (NITHIPO), the Town of Montague, the Town of Gill and other interested tribes and organizations, and as a conservator of one of the largest and oldest village and cultural gathering places on the whole of the Connecticut River, would like to elevate the awareness of the cultural, and ceremonial history of the Great Falls and Ceremonial Hill locus and beyond, including the historical events surrounding the Great Falls Massacre of May 19,1676, to reflect the importance of the Native American cultural life ways that are so uniquely concentrated in this area for the purpose of preservation and education. Nolumbeka seeks to stimulate one of the newest recreational activities catching on all over the world, Recreational Historical Tourism. Our goal is to bring awareness to Native culture and history and with the success of that, tourist dollars into the area to help ensure the continued protection and preservation of ancient sacred sites, the 12,000 year old trail systems and fishing stations, the expanded ceremonial stone landscapes, burial grounds and battle grounds sites and other cultural resources in this area and further up north on the Connecticut River including Vermont's petroglyph's and ceremonial stone calendar sites. One of the first steps is to identify and acknowledge as many of the cultural assets eligible for listing on the National Register of Historic Places as possible.

An important statistic to take into consideration on this subject is that Massachusetts, Vermont and New Hampshire seem to be lagging behind many other states in the country on their preservation efforts around Native American Cultural Resources. The chance of a Native American site being listed on the National Register of Historic Places in Massachusetts is 1 out of 300, in Vermont, it is 1 out of 147.2, In New Hampshire it is 1 out of 105 while in places like Maine it is 1 out of 12.7.
If this is going to be a 50- year license issue, it will reflect a 50 year lock in on the States and Licensee's attitude around the their responsibility to preservation efforts of our Native American cultural assets and resources here in the Connecticut River Valley. Nolumbeka Feels it is time for Massachusetts, Vermont and New Hampshire to elevate our collective Native American cultural preservation responsibilities to that of other states like Maine. Nolumbeka feels that a comprehensive TCP is an important first step.

Public Interest Consideration If Requester Is Not A Resource Agency

Section 106 of the National Historic Preservation Act (1966) requires that federal agencies, licensees, and those receiving federal assistance take into account the effects of proposed undertakings on any resource that is listed on or is eligible for the NRHP.
The Nolumbeka Project considers our organization a limited resource agency. The Nolumbeka Project represents the following public interests: historic cultural tourism, preservation of sacred sites and ceremonial stone landscapes, a wider public interest in educational and artistic Native American events such as an annual Narragansett and Town of Montague proposed tribal canoe race on the Connecticut River to coincide with a popular Peoples Harvest Native American art music and history event, and the desire for the Town of Gill and Montague to create a Native American cultural educational park.

Existing Information and Need for Additional Information

Sections 4.10.2.3 and 4.10.2.4 of the Pre-application Document (PAD) described the Woodland Period (1000BC-AD1600) and the Contact Period (AD1500-AD1620) generally. This should include Paleo-Indian (12,000-BC-AD1676) Contact Period.
The Gill Riverside Historic District is listed as eligible for The National Register of Historic Places as well as the Turners Falls Ceremonial Hill, which is listed as a district with a 20-mile radius around the Turners Falls Airport.
There is the historic May 19,1676 Great Falls, Peskemoskut massacre site to take into consideration, including an intact parcel of that site at the top of the hill in Gill known as the Conway Site. That property had a ground penetrating radar (GPR) survey done several years ago, that produced the indication of nearly 300 unmarked burials including a very rare Spokes Burial commonly associated with the Andean culture, as well as the recent discovery of an additional Spokes Burial located not far from the one discovered in the late 1890's on the Conway site.
There is the 12,000-year-old Wissatinnewag Village site that Nolumbeka holds the deed to, located at the foot of the Great Falls, which includes a built earthworks traversing trail system going down to fishing and canoe launching stations on what was the shore line of ancient Lake Hitchcock and later in time on down to the rivers edge that accesses what is now known as the By-Pass Reach section of the river. That access point proved to be a

highly productive fishing area. The Wissatinnewag trail system also supports a number of ceremonial stone structures that directly relate to the line of sight and ceremonial connection to the Ceremonial Stone Hill at the Turners Falls Airport, as well as a large number of burials up higher on the village site. All the sections of the village site are still used today by the tribes for ceremony and other traditional practices associated with their past cultural life ways. Wissatinnewag today is a live and vibrant historical piece of property made fully accessible to the tribes and is used for the growing of Native heritage crops and seed preservation as well as education.

There is the rare 12,000-year-old Hannaman Paleo-Indian Hunting and Kill site located at the foot of the Ceremonial Stone Hill.

There are islands below the falls that were used for seasonal fishing and village sites where there are ancient shell middens on the islands north ends that could reveal a great deal about the aquatic resources that were used by the inhabitants for thousands of years. By investigating these shell middens researchers could discover what was being harvested from the river for food and utility and what the environmental health of the river was during the time of these middens. This investigation might reveal new information about the shellfish population as well as the sturgeon populations that existed at that time. There are shell middens in the Rock Dam area that should be investigated as well. Also in the Rock Dam area there were burials eroding out of the rivers edge that are well documented.

Under the waters of Barton's Cove there is an extension of the Great Falls village that was for years kept in preservation as pastureland but was later flooded by the raising of waters associated with the rising level of the dams to produce hydropower. This village was part of the 1676 Turner attack on the village of Peskeomskut. Somewhere under the waters of Barton Cove is the mouth of Heal All Brook where forges, muskets and pigs of lead were thrown into the fast flowing waters on the morning of May 19, 1676 during that predawn attack.

In the project area is the Kells Farm Site just south of the By-Pass Reach that has proven to be a very important Paleo-Indian to Contact Period village site. Some of the artifacts in known collections from that site have revealed a high concentration of ceremonial burial items. On the Kells Site there are also a large number of ceremonial stone markers that indicate part of the site was used for sacred practices and ceremony. Some of the stones have very interesting markings on them that might prove to be useful to expand the level of knowledge surrounding ceremonial stone sites.

There is an extension of the Wissatinnewag Village that connects with that part of the Wissatinnewag Village that The Nolumbeka Project owns. That site is has had less impact than some parts of our section of the village and should be taken into consideration in a TCP study.

To date, there has been no comprehensive professional cultural properties inventory of the Project APE to identify such resources. The Nolumbeka project feels this is a necessary part of the re-licensing regulatory process. Also Nolumbeka feels that recognition of historical structures should be applied to ceremonial built stone structures and the built earthworks of the engineered steep slop Indigenous trail systems and fishing stations.

Nexus to Project Operations and Effects.

First Light's continued operation and maintenance of the Turners Falls Dam and Northfield Mountain Pumped Storage Projects has a potential to affect TCPs especially due to erosion and under monitoring of cultural properties from looting and limited knowledge of ceremonial practices and recognition of sacred cultural resources.

Under Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, federal agencies must take into account the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment on such undertakings. As defined under 36 CFR 800.16(l), historic properties are prehistoric or historic sites, buildings, structures, objects, districts, or locations of traditional use or beliefs (i.e., TCPs) that are included in, or eligible for inclusion in, the National Register of Historic Places (NRHP). Historic properties are identified through a process of evaluation against specific criteria. For most cultural resources evaluated for listing on the NRHP, these criteria are found at 36 CFR 60.4.However, to be considered a historic property, a TCP must meet other significance criteria identified in amendments made to the NHPA in 1992. These criteria are found at§101(d)(6)(A)

Proposed Methodology

Task 1: Establish study area

The study area should be the same APE determined by the State Historic Preservation Offices (SHPOs) and Narragansett Indian Tribal Historic Preservation Office (NITHPO), after consultation with knowledgeable local contacts and organizations including The Nolumbeka Project.

Task 2: Research archives

The Nolumbeka Project archives are available for use in this process, also the University of Massachusetts (U-Mass) Archaeological Services Archives can be tapped, but with the caveat that they often list research locations and studies under a number of different names for the same locus. This has in the past, allowed for a disconnect of access to the full body of knowledge on a given site if it was listed at one time or another under a different name. There are local highly knowledgeable researchers at The Nolumbeka Project, and the Narragansett (NITHPO) have access to cultural practices and information that could expand on the body on knowledge of this area, as well as other local researchers. The research library at the Pocumtuck Valley Memorial Association Library (PVMA), (the Memorial libraries) in Historic Deerfield library up stairs collection, U-Mass library, is an expanded body of knowledge. The Historic Commissions in the surrounding towns and the Historical Society in Northfield and Gill, Carnegie Public Library in Turners falls has land improvement maps that show what was done in the Gill Riverside and Turners area. The records of the Massachusetts, Vermont and New

Hampshire SHPO’S should be reviewed. . Look for private and public manuscript collections, pictorial resources and maps, including local newspaper archives, articles and the Kells Farm Family Private Artifacts Collection.

Task 3: Tribal Consultation and Identification of Resources

Following the ethnographic literature review suggested in step 2, the next step in identifying potential TCPs will involve extensive tribal and local researchers consultation. Consultation and the necessary fieldwork and potential TCPs documentation shall be in accordance with Section 106 of the NHPA, as amended, and shall be consistent with the National Register Bulletin No. 38, Guidelines for Evaluating and Documenting Identification of Traditional Cultural Properties (Parker and King 1998).

In order to facilitate tribal consultations, the Licensee’s are requested to retain a qualified, professional ethnographer who meets the standards for ethnography as defined in Appendix II of National Register Bulletin No. 38. The Licensee’s will coordinate its selection of the ethnographer with the assistance of affected tribes and other interested cultural/tribal stakeholders including the Nolumbeka Project anthropologist

The ethnographer, in consultation with tribal representatives including the NITHPO and other tribes and stakeholders will determine the scope and breath of interviews. It will be the responsibility of the ethnographer to contact the appropriate tribe(s) and interested tribal and cultural stakeholders to arrange for interviews at a time and location acceptable to those tribal Interviewees. The ethnographer and tribal interviewees may need to visit the APE together to accurately define potential TCPs or other ethnographic and non-TCP cultural resources of importance to the tribes. It may be necessary for the Licensee’s to arrange for an initial introductory meeting bringing together the Licensee’s, tribal representatives, and the ethnographer.

Interviews will often need to be conducted on a one on one basis with the ethnographer. The oral traditions and information collected during interviews will be used to help define the potential TCPs, or other cultural resources of tribal significance in the APE, and assist in making sound judgments and resource management and other decisions in the Projects planning. If during tribal interviews the ethnographer and interviewees determine it appropriate, the Licensee’s ethnographer will coordinate with tribal interviewees to obtain Traditional Ecological Knowledge. The sole purpose of addressing Traditional Ecological Knowledge (TEK) will be to identify important tribal locations and cultural resources within the APE.

If participating tribes do not wish to disclose the locations of any potential TCPs or other cultural resources, the Licensee’s will instead work with the tribes to identify the general issues and concerns that the tribes(s) may have regarding potential impacts of the Project upon resources known to the tribe(s) and further work with the tribes and appropriate land management agencies to develop agreeable measures to address these concerns.

Step 4-Site Visits

Capable tribal representatives, and stakeholders including The Nolumbeka Project researchers and the Licensee's ethnographer may wish to visit archaeological sites including (Wissatinnewag and the Kells Farm as well as the islands and shell middens and the petroglyphs locos containing artifacts, features, scared artwork or other physical remains from past human activities) identified during the study or during the Licensee's Historic Properties Study. The purpose of the visit would be to provide tribal representatives the opportunity to exam any archaeological sites of interest to the tribes that were encountered during the Historic Properties Study fieldwork, and to enable the ethnographer to obtain additional information on the potential TCPs that may be associated with the sites. The licensee's or their enthrpgrapher will make a reasonable effort to reach out to the participating tribes to invite participation in archaeological site visits by calling, sending letters or through electronic mail.

Step5-National Register of Historic Places Evaluation

Following the completion of step 4, the Licensee's ethnographer will evaluate the eligibility of identified TCPs and other cultural resources of tribal importance for listing on the NRHP using the data collected from the field studies described above. This will be done in consultation with participating tribes. The amendments in 36CFR 60.4 to the NHPA in 1992 (ss101(d)(6)9A0) specify that properties of traditional religious and cultural importance to a tribe may be determined eligible for inclusion in the NRHP because of their "association with cultural practices or beliefs of a living community that are: 1) rooted in that community's history; and 2) are important in maintaining the continuing cultural identity for the community." Nolumbeka believes that both criteria exist in the Great Falls area for a number of tribes.

All TCP that are evaluated at this phase will be done with the affected tribes, the appropriate federal agencies and the SHIPOs. Those evaluations will be submitted to the appropriate agencies and tribes for review and comment prior to final submission to the SHIPOs for concurrence. The Licensee's will work with the tribes regarding resources of tribal importance that may not qualify for the NRHP, or resources the tribes may have regarding potential impacts of the project upon resources known to the tribes. The Licensees will work with the tribes and land management agencies to develop agreeable measures to address these concerns.

Step 6-Identify and assess Potential Project Effects on National Register Eligible Properties

As required under 36 CFR ss 800.5 the Licensees will identify and assess any adverse affects on TCPs resulting from Project O&M. Adverse effects are defined as follows:

An adverse effect is found when an undertaking may alter, directly or indirectly any of the charteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the properties location, design setting, materials, workmanship, feeling, or association. Consideration shall be given to all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the National Register. Adverse effects may include reasonably foreseeable effects caused by the undertaking that mat occur later in time, be further removed in distance or be cumulative (36 CFR ss 800.5 (a) (1).

Step 7-Reporting

The Licensees will prepare a report at the conclusion of the study that includes the following sections;1) Study Goals and Objectives; 2) Methods: 3) Results; 4) Discussion, and; 5) Description of Variances from the FERC-approved study proposal, if any.

Copies of this report will be provided to the affected Indian tribes including but not limited to the Narragansett NITHPO, interested stake holders including but not limited to the Nolumbeka Project research staff, and other interested parties. Interested parties will be provided the opportunity to review the TCP report before it is sent to the SHIPOs for concurrence.

Step 8-Consistency of Methodology with Generally Accepted Scientific Practices

The proposed study methods listed above should be consistent with ACHP's guidelines foe compliance with the requirement of Section 106 of the NHPA found at 36 CFR 800 and with the related guidance set forth in National Register Bulletin 38.

Level of Effort and Cost

We estimate that this study will cost $50,000 - $100,000

References

Parker, Patricia L., and Thomas F King, 1998. Guidelines for Evaluating and Documenting Traditional Cultural Properties. National Register Bulletin 38. U.S. Department of the Interior, National Parks Service, Washington, D.C.

Joseph Graveline, President
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In Reply Refer To:
TransCanada Hydro Northeast Inc.
Vernon Hydroelectric Project, FERC No. 1904
Bellows Falls Hydroelectric Project, FERC No. 1855
Wilder Hydroelectric Project, FERC No. 1892

July 15, 2013

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

Dear Secretary Bose:

This responds to the updated Proposed Study Plan (PSP) submitted by TransCanada Hydro Northeast (TransCanada) on July 8, 2013 as part of the relicensing of the Vernon, Bellows Falls and Wilder projects, located on the Connecticut River in Vermont and New Hampshire.

Background

TransCanada filed its initial draft PSP on April 15, 2013. Subsequent to that filing, TransCanada conducted six full day meetings between May 13 and June 12, 2013. Substantial technical comments and recommendations on most of the proposed studies were provided by the U.S. Fish and Wildlife Service (Service) and other parties at the meetings. Based on those comments and recommendations, TransCanada indicated that they would be making significant changes to the proposed study plans to expand on, clarify or modify individual study proposals.

By letter dated June 13, 2013, the Service requested a 15-day extension of time (EOT) of the July 15 2013 deadline for filing comments on the updated PSP. By letter dated June 28, 2013, the Federal Energy Regulatory Commission (Commission) denied the Service's EOT request.

The Service is providing the following remarks for your consideration. These comments were prepared following our review of both the initial and updated PSP, and include information obtained from multiple study plan meetings. We note that the late filing of the updated PSP, coupled with the Commission's denial of our request for an EOT, has regrettably affected our ability to thoroughly review and prepare within a reasonable time frame, essential comments and recommendations on the updated PSP. We believe this denial will also affect other interested parties' ability to adequately review recently submitted materials, prepare and coordinate their comments with other involved parties, and restrict their input during this process. This will unfortunately result in less thorough and comprehensive comments and recommendations being developed and has the likelihood of adversely impacting the interest of all parties, including the Applicant who has expended an enormous amount of time and effort to assure that adequate studies are being considered, developed, and performed. We also note that, as a result of the reduced time frame, our hydraulic engineer will not be available to review some study plans by the July 15, 2013 submittal deadline. Therefore, additional comments on those plans may be provided at a later date, or in response to the Final Study Plan.

Updated Study 4 – Hydraulic Modeling Study

We have no comments on this study at this time.

Updated Study 5 – Operations Modeling

Methods

The plan proposes to define econode relationships with flows and downstream node elevations using output from the hydraulic model. To ensure accuracy, the hydraulic model cross-sections and the Vita model econodes should be at the same location. The updated PSP is not clear on the relationship between these locations.

At the study plan meetings, there were discussions pertaining to the development of a two-dimensional rating curve for "interzone" areas where there is a transition from ponded to riverine conditions, so that the relationship between upstream and downstream project operations could be assessed. In addition, there was discussion on the use of an optimization model to run various operation scenarios. Neither of these concepts are included in the updated PSP, but should be discussed and included in the final plan.

Deliverables

At the study plan meetings, we requested the model data set. The Vista model is proprietary, but TransCanada indicated that the HEC-RAS input hydrology set would be provided. This should be clarified in this section of the updated PSP.

Updated Study 6 – Water Quality Monitoring and Continuous Temperature Monitoring

We defer comment on this study to the New Hampshire Department of Environmental Services and the Vermont Department of Environmental Conservation.

Updated Study 7 – Aquatic Habitat Mapping

The updated PSP reflects changes discussed at the study plan meetings relative to mapping at high pond levels and discussion of additional water surface elevation monitoring.

Updated Study 8 – Channel Morphology and Benthic Habitat Study

We have no comments on this study plan.

Updated Study 9 – Instream Flow Study

Dual Flow Analysis

The updated PSP includes a dual flow analysis component to assess the amount of habitat that remains suitable over a given range of project discharge flows as was recommended by the Service and other parties. TransCanada proposes to assess "some immobile aquatic species or life stages." Some species and life stages, like freshwater mussels or deposited fish eggs, are clearly immobile or otherwise unable to respond to flow fluctuations from peaking power operations. However, other species and life stages are also impacted by fluctuating flows in less obvious ways. Flow changes can affect the location of suitable habitat, and would necessitate the movement of the individual fish to a different location in the river upon each flow change. If these locations are dispersed or distant from each other, the fish could be displaced from the flow change itself, or need to actively search for the now relocated habitat areas and possibly move substantial distances to find suitable habitat. The consequences of these movements could be vulnerability to predation, energy expenditures to search for and relocate to suitable habitat. Therefore, as noted by the Vermont Department of Fish and Wildlife (VDFW) at the study plan meetings, the Dual Flow Analysis should also be conducted on smaller fish species and life stages. Determination of what species and life stages would be assessed using Dual Flow Analysis should be made in consultation with the Service, the VDFW, the New Hampshire Fish and Game Department, and parties on the Aquatics Working Group.

Deliverables

We note that the results of the Dual Flow analysis should be listed in the list of deliverables from the study. In addition, the Service and other parties also recommended including in the analysis, mapping of habitat at various flows to show how the location of suitable habitat changes at various flows. This analysis can be derived from the PHABSIM data.

Updated Study 10 – Fish Assemblage Study

Study Area and Study Sites

We note that TransCanada now proposes to sample downstream of the Vernon Dam (to Stebbins Island). We support the inclusion of this area, as it remains unclear which project's operations exert the most influence over this reach of river.

Methods

The updated PSP contains a modified study design that addresses some of the comments and concerns raised during the June 6, 2013 study plan meeting. Rather than sample a set number of segments within each general reach of the impoundment (upper, middle, and lower), the geographic area (from the upper limits of the Wilder headpond downstream to Stebbins Island) has been divided into seven strata that generally break down by project and impounded versus free-flowing habitat. TransCanada will sample 12-15 randomly selected 500-meter segments within each strata, with the exception of the Bellows Falls bypass reach, which, due to its relatively short length, would have five segments.

While TransCanada has incorporated randomization into the study design, the recommendation to conduct replicate sampling has not been adopted. Further, according to the updated PSP, boat electrofishing will be the primary sampling method within each 500-meter segment, unless access within a particular strata is limited and does not permit boat shocking. It seems likely that a given strata may contain some areas that are conducive to boat electroshocking and some areas that are not. Based on the above, the Service recommends that TransCanada modify the proposed sampling design to stratify by habitat type. The number of sampling stations would be proportional to the amount of that habitat relative to other habitat types. For example, if setback habitat within the defined geographic area represents 15 percent of all habitat, 15 percent of the stations should be in this habitat type (with each particular station randomly chosen). To address the concern of replication, we recommend that a minimum of three replicates of each habitat-specific type be sampled at each station. These modifications would help address stakeholder concerns and should result in a broader diversity of habitats being sampled effectively.

It is unclear to the Service why TransCanada has lowered from 50 down to 35 the number of fish of any one species from which individual length and weight data would be collected. Also not specified is how those 35 fish would be chosen. Would it be the first 35 fish, or would a certain number from each visually assessed length class be measured and weighed? The Service recommends that TransCanada follow the protocol specified in FirstLight's Fish Assemblage study plan: "..all captured fish will be identified to species, classified as adult, juvenile or Young-of-Year (YOY), enumerated, weighed, measured for total length and then released. If large numbers (n>25) of small fish (YOY fish or cyprinids less than 100 mm) are captured they will be grouped by size class, enumerated, and batch-weighed with length measurements only taken from one large and one small representative specimen within each group."[1] In order to be able to adequately assess the size structure and health (i.e., condition factor) of the population, all individual fish of a given species need to be measured and weighed (or, at a minimum, a representative subsample within each length class).

The Service supports the reduction in gill net set time, as this addresses concerns raised by the VDFW regarding excessive mortality with this gear type under the initially proposed 24-hour set time. Likewise, we concur with adding in trap nets as a potential gear type.

Analysis

The analysis should be modified according to our proposed changes to the sampling design described above; any summary statistics generated should be by habitat type rather than stratum. We are unsure what TransCanada means by "Effort will be made to incorporate a size class component." At the June 6, 2013 study plan meeting, the Service recommended that the analysis

1 FirstLight Updated Preliminary Study Plan for the Turners Falls Hydroelectric Project (No. 1889) and Northfield Mountain Pumped Storage Project (No. 2485). June 28, 2013. Page 3-181.

should include a size class breakdown for catch per unit effort per fish species. Given that length and weight will be collected on sampled fish, there should be no reason why that information should not be analyzed and reported; why collect those data if they will not be used? Those data are what is needed to provide an overall picture of the fish assemblage: what species are in which habitats (during which seasons), how many of each species, what size classes, and in what condition.

Deliverables

The Service requests that TransCanada provide the raw data, in digital format, to stakeholders, upon request.

Updated Study 11 – American Eel Survey

Methods

Electrofishing Surveys

TransCanada has modified the study design from sampling a defined number of transects upstream of each dam to a specified number of segments within a given strata. While the overall number of sampling events will increase, because each segment is 500 meters (versus the original proposed 1,000 meters), the net result is that less habitat will be sampled. For example, at Wilder, originally 17.4 miles of river were to have been sampled, whereas only 11.1 miles will be sampled under the updated PSP. While this decreased effort is of concern, the increased number of sampling events and randomized design may result in an increased number of habitats being surveyed; therefore, the Service does not object to this change.

Eel Traps

In response to comments raised during the May 23, 2013 study plan meeting regarding the number of eel traps initially proposed, TransCanada has changed the survey methodology similar to the electrofishing survey: the geographic area will be divided into strata of 500-meter segments and eel traps will be placed in a specified number of randomly selected segments within each strata. The net result is an increase in the number of eel traps deployed. The Service supports this change.

Updated Study 12 – Tessellated Darter Survey

Methods

The updated PSP proposes use of an electrified benthic trawl to effectively sample darters. On the June 21, 2013 conference call regarding various studies, we raised the concern about the potential impacts of the trawl on the federally listed endangered dwarf wedgemussel (DWM) (*Alasmidonta heterodon*). Potential impacts would include capture, relocation or disturbance of DWM. The trawl sampling is proposed to target areas with DWM, since the darter study itself is predicated on the fact that tessellated darters are the host species for the DWM's glochidia life stage.

In response to those concerns, TransCanada has provided some explanation of how they believe that neither the trawl itself nor the electric current that DWM could be exposed to are likely to cause adverse impacts. It states in the updated PSP that the trawl is unlikely to gouge the bottom habitat, and that the trawl net could be affixed with additional exclusion netting at the bottom to reduce collection of mussels (as well as rocks and other bottom debris). Alternatively, TransCanada has suggested they could modify their sampling protocol and avoid areas with DWM, after data on DWM occurrence in the project areas are completed this year as part of TransCanada's DWM study plan (Study 24).

We cannot determine whether the proposed use of a modified trawl would avoid adverse effects to adult or juvenile DWM without supporting documentation or evidence that the modifications have been successfully implemented elsewhere. Avoidance of areas known to support DWM would minimize or avoid the likelihood of adversely affecting DWM; however, this sampling scheme might not provide the data needed to assess potential impacts from the proposed relicensing. Therefore, we recommend further coordination with the Service in the refinement of the study design in order to develop a study plan that will provide sufficient data on tessellated darters and also fulfill Endangered Species Act (ESA) requirements.

Because the tessellated darter survey most likely will occur within occupied DWM habitat, it is likely that there will be effects on individual mussels or glochidia. The Commission will need to initiate consultation and provide an effects determination to the Service and request our review and concurrence (under section 7 of the ESA) once a Final Study Plan has been developed.

Updated Study 13 – Tributary and Backwater Access and Habitats Study

Methods

In response to concerns raised during the May 20, 2013 study plan meeting, TransCanada has modified the updated PSP to include consultation with the Aquatic Working Group with respect to evaluating the preliminary data and selecting sites for further, intensive study. The Service supports this change. However, as the plan now reads, it is unclear to us what screening metrics will be used to identify those "shallow inlets and shoal areas with the greatest chance of impeding fish movement." Will it be the 1-foot depth criterion cited later in the section, or some other measure? If it is the former, it would seem unnecessary to meet with the working group, as there would be no need to further reduce the number of sites to monitor in 2014 (i.e., all of the sites meeting that criterion should be evaluated).

The protocol for monitoring the selected sites is confusing. Selected sites would have water level recorders installed and operated for one year. Water quality data would only be collected at those sites if access to the main river is found to be impeded. However, the reason those sites were selected is because they had water depths less than 1 foot; therefore, water quality data should be collected at all of the selected sites.

Analysis

The updated PSP is not clear on how the collected data will be presented. The Service recommends that one of the products be bathymetric maps of all selected sites, showing the location where the recorder was installed. Not only will it be important to know how depth changes seasonally and with project operations, but also how wide that minimum depth is as it relates to zone of passage.

Updated Study 14 – Resident Fish Spawning in Impoundments Study

Methods

One element raised at the May 23, 2013 study plan meeting that does not appear to have been incorporated into the updated PSP is the need for TransCanada to consult with the state fisheries agencies regarding specific locations to target for monitoring. State fisheries biologists have substantial on-the-ground experience and knowledge that should be used to assist in identifying potential spawning sites.

The Service recommends adding the eastern silvery minnow as a target species that depends on backwater coves for spawning.

Updated Study 15 – Resident Fish Spawning in Riverine Sections Study

Study Goals and Objectives

The Service supports the inclusion of the reach downstream of Vernon Dam as a location to assess impacts of the project on spawning habitat and spawning activity by resident fish in riverine habitat.

Methods

As noted under our comments on Study 14, the Service recommends that the updated PSP include consultation with the state fisheries agencies regarding specific locations to target for monitoring. State fisheries biologists have substantial on-the-ground experience and knowledge that should be used to assist in identifying potential spawning sites.

In addition to the physical and chemical data TransCanada proposes to collect at identified spawning locations, the Service recommends assessing for effects of scouring and sedimentation, as these can impact egg survival.

Updated Study 16 – Sea Lamprey Spawning Assessment

The updated PSP has been modified to provide additional clarity on nest sampling protocols and data collection on nests that was requested by the Service and other parties at the study plan meeting on June 6, 2013. We concur with those modifications.

Methods

The study proposes use of radio-telemetry to identify lamprey spawning locations in the project areas. We endorse this proposed method. However, given the limited number of radio-tagged lampreys and the large areas of mainstem and tributary rivers that lampreys could disperse to, we recommend that TransCanada also utilize the data from the Hydraulic Modeling Study (Study 4) and Aquatic Habitat Mapping (Study 7) to locate potential areas of lamprey spawning habitat based on substrate and depth criteria or lamprey spawning and incubation. During the course of this and other studies, these areas could be observed for lamprey spawning concentrations that may not be identified by the radio-tracking survey if no tagged individuals select those sites. If any such areas offer different habitat conditions from those occupied by tagged individuals, they may be appropriate for inclusion in the nest monitoring phase of the study and/or provide potential unique habitats for evaluation in the Instream Flow Study (Study 9). Addition of this component would strengthen the study plan by providing an alternative method to identify spawning areas and potentially expand the geographic location and habitat conditions that could be evaluated for project effects.

Updated Study 17 – Upstream Passage of Riverine Fish Species Assessment

Study Goals and Objectives

The updated PSP clarifies that fish passage operations to assess passage of riverine fish species will be conducted from early spring to late fall and encompass the entire "open water" period, when freezing temperatures would lead to icing of project equipment. We concur with this time period for the study.

Methods

Based on discussions at the June 21, 2013 study plan meeting, the updated plan provides detailed description of the use of video monitoring using the Slamonsoft digital video counting system. We concur with the proposed counting and monitoring methods.

At the meeting, TransCanada indicated a desire not to have fishway shutdowns and inspections due to the time and logistics of carrying out multiple shutdowns of three fishways. We indicated that although we understood that rationale, we were concerned that debris accumulation in the ladders during extended fishway operations could disrupt ladder hydraulics and affect passage.

In response, TransCanada has proposed that inspections of the facility will also include visual observation of the ladders to identify if hydraulic changes occur, and if so, a shutdown, inspection and ladder cleanout may be implemented. While we would agree that most major blockages may be visible on inspection while operating, less dramatic changes in ladder hydraulics may be less obvious. Therefore, we recommend that the three ladders be inspected at the end of the 2013 season, to assess debris accumulation after the spring operation period in 2013, and that this information would be used to evaluate if there is a need for one or more inspection and clean-out during the ladder operation for this study.

In addition, we recommend that the study plan require consultation between TransCanada and the Service regarding inspections and TransCanada decisions on whether or not to dewater and inspect the fishways during the study period. This consultation on observation data would assure that the Service and other parties all agree that fishway monitoring results are valid and were not affected by ladder operating conditions

Updated Study 18 - American Eel Upstream Passage Assessment

Study Goals and Objectives

In response to concerns raised by the Service at the May 23, 2013 study plan meeting, TransCanada has modified the study design to conduct the systematic surveys in study year one and deploy the temporary eel trap passes in study year two (rather than perform both tasks in the same study year). The Service supports this change.

Methods

Temporary/Portable Eel Trap Passes

TransCanada states that "Prior to the installation of any temporary eel trap passes during year one..." The Service believes this should read "...during year two." Regardless, we support the general point of the sentence that TransCanada will consult with the Aquatics Working Group prior to selecting locations to deploy the eel trap passes.

The Service is concerned with TransCanada's proposal to limit the number of eel trap passes to two per project. Given the number of possible areas of concentration at each project, it is possible that more than two eel trap passes will be needed. The Service recommends that the number of eel trap passes required at each project be determined in consultation with the Aquatics Working Group, based on the results of the systematic surveys conducted in year one.

Updated Study 19 - American Eel Downstream Passage Assessment

Methods

FirstLight states that mortality and injury of silver eels may be assessed at non-turbine routes (as recommended by the Service and others), depending on the results of the route selection study; if a "significant" proportion of fish use non-turbine routes, TransCanada will consult with the Aquatics Working Group and consider options to assess those routes. The word "significant" is somewhat ambiguous unless it is being used in the statistical sense, which we do not think is the case for the subject study; therefore, we recommend replacing it with the word "substantial."

However, as we noted on the June 21, 2013 conference call on various studies, without assessment of spill survival, there will be no information to compare that passage route with turbine passage. If turbine passage proves to inflict high mortality, there will be no information upon which to evaluate if spilling water at the dam might provide a safer alternative route and potentially suggest a way to mitigate for project impacts. This assessment would likely be needed later if that is the case, and it may be more economical to do this assessment concurrently with the other survival evaluations in addition to putting eel survival through the turbines in context of other routes.

Route Selection

TransCanada states that radio-tagged eels will be monitored from late August through mid-October. The Service recommends that monitoring continue until all test eels are confirmed to have left the study area (or the tag life has expired, whichever occurs first).

Survival/Injury Studies

In this section, TransCanada states that a minimum of 50 eels with HI-Z Turb'N tags will be released at each project, with the exact number to be determined in consultation with the Aquatics Working Group. However, earlier in the plan, TransCanada stated that it will proportionally allocate the number of eels tested (150) by the number of different turbine types. The Service recommends that a minimum of 50 tagged eels be released into each turbine type, per project. Given that there is one turbine type at Bellows Falls, two types at Wilder, and three types at Vernon, a total of 300 test eels would be needed. This is the number of eels FirstLight proposes to use in its balloon tag study, and the number the Service used in its study request ("A minimum number of 50 tagged eels...will be required at each location...station turbines").

According to the updated PSP, eels would be injected into the turbines while at or near full generation. The Service is concerned that restricting the test to one operational condition may be insufficient to evaluate overall turbine mortality. If peak efficiency is at a flow less than full generation, that condition also needs to be evaluated. Likewise, if the units sometimes are operated at minimum gate, that also needs to be evaluate. Testing at these other loads is necessary, as turbine survival is known to vary depending on turbine unit operations. However, if TransCanada provides data showing that the turbines only operate at one setting for the duration of the adult eel outmigration period, testing only that one condition will suffice.

Analysis

Route Selection

If analysis of the routing data indicates preference for spill routes and resultant poor survival, additional consultation with the Aquatics Working Group would take place to discuss the need for additional survival estimates and studies. Given that the proposed radio telemetry tags would not have a motion sensor or other mechanism from which to determine the fate (i.e., alive or dead) of the eel, it likely would be difficult to use the information to assess survival (which is why a separate directed mortality study was requested).

Deliverables

All data used to develop the report should be made available to stakeholders (upon request) in digital format, including all telemetry and PIT tag data.

Updated Study 20 - American Eel Downstream Migration Timing Assessment

At the May 23, 2013 study plan meeting, the VDFW suggested that data from Study 17 (Upstream Passage of Riverine Species Assessment) could be used to inform the subject study. The updated PSP addresses this suggestion. The Service supports incorporating relevant data from other studies being conducted either at TransCanada's projects or FirstLight's projects, once they become available. In particular, the hydroacoustic data that FirstLight will collect both at the Northfield Mountain Pumped Storage (NMPS) and the Turners Falls projects could provide valuable information regarding the timing of eel outmigration on the Connecticut River.

Schedule

The updated PSP indicates that the study will occur in 2014. While the literature review portion of the study could be conducted in 2014, the final report, if it is to incorporate data collected from other studies, will not be finished until late in 2014. Therefore, the study likely will not be completed until 2015. Alternatively, TransCanada could release a draft report in 2014, and a revised report in 2015 once information from other relevant studies becomes available.

Updated Study 21 – American Shad Telemetry Study

Methods

The updated Methods section includes more planning details that will occur in consultation with the Aquatic Working Groups. There is a statement that tagged shad will be manually tracked and spawning areas located, but it is not stated at what frequency mobile tracking will occur. Given the length of the reach from Bellow Falls to Vernon, we expect that the entire reach could be covered in one day, therefore we are assuming that the entire reach will be surveyed. This point should be clarified. Consistency with previous study approaches used by Conte Laboratory will be beneficial as will the additional review of study data from 2011 and 2012. Radio receiver and PIT reader coverage appears well designed to meet study objectives and is shown in figures and described in detail. The use of motion and temperature reporting tags was requested and has been incorporated.

Sample sizes of tagged shad were increased from the original proposal to include 50 double tagged (radio/PIT) shad from Holyoke for release in the upper Turners Falls Dam Pool. A matching pair of 50 single PIT-only tagged shad will also be released in this area. As noted with FirstLight Power's shad telemetry plans, fallback of shad from trapping, handling, tagging, and transport may reach 40 percent. This would potentially mean that there will be only 30 radio (double-tagged) shad remaining for study. As noted, it is expected that FirstLight study fish, with coordinated radio tag frequencies, code sets, and codes will supplement this number. Therefore, we recommend increasing the proposed sample size to allow for evaluation of study objectives over the entire upstream shad run at Vernon and associated varied operational and environmental conditions.

The methods include no discussion of the timing of tagged fish releases. Shad should not be released in a limited time window. Spreading out releases would reduce concerns about radio tag code collisions and allow for increased sample sizes to be released in three batches. However, we also recommend shifting the release periods to the early and middle parts of the run to avoid the increased losses of fish that occur with later releases. At the May 23, 2013 meeting, TransCanada stated that restricting the number of releases was not based on the cost of additional radio tags, but rather to assure the quality of the data. We believe that additional quality data can be obtained if the study design is modified to include three batch releases of 30-40 double-tagged fish per batch (with paired single PIT-tagged fish) to accounting for fallbacks. Releases could be spaced at ten-day intervals, spanning the month of May.

The planned release of 50 double tagged shad into Vernon Dam Pool should be adequate with recent observed passage rates and the suggested increase in study fish releases below Vernon, with the additional fish from FirstLight also supplementing the available sample. As noted with the releases below Vernon, several release groups would be desirable upstream of Vernon to better represent variable and changing conditions (operational and environmental) over the period of early May to early June.

The study proposes nighttime observation periods for spawning activity that will commence once radio-tagged shad are detected and suitable water temperatures are occurring upstream of Vernon Dam. Observations are proposed to occur every night after that trigger is reached but the duration of the monitoring each night is not specified. Existing literature indicates that shad spawning does not extend very late into the night, therefore rather than setting specific hours of observation, we recommend that the updated PSP indicate that observations will continue until spawning ceases each night.

Analyses

The outlined analyses appear appropriate. All data used to develop the report should be made available to stakeholders (upon request) in digital format, including all telemetry and other data.

Updated Study 22 – Downstream Migration of Juvenile American Shad - Vernon

Study Goals and Objectives

In response to feedback provided by stakeholders at the May 23, 2013 study plan meeting, TransCanada has modified the goals and objectives of this study. The Service believes the updated goals and objectives address some of the concerns raised at the meeting.

Methods

The updated Methods section includes the addition of video monitoring to assess the timing of the juvenile shad outmigration. This new method was proposed in response to the Service raising a concern with relying solely on radio-tagged juveniles and Turbine Tag juveniles that may or may not represent the natural timing, duration, and magnitude of wild fish outmigration(s) and the operational/environmental conditions that are occurring in those periods of natural movement. The Service recommended the use of hydroacoustics in the Vernon Dam forebay to quantitatively determine timing, duration, and magnitude of the juvenile outmigration, which would provide important context to the limited number and release timeframe of radio-tagged juvenile fish releases.

The May 23, 2013 meeting stimulated significant discussion on the topic of hydroacoustic evaluations used at Vernon in an unsuccessful juvenile shad study in 2009. The Service's Connecticut River Coordinator has contacted Hydroacoustic Technology Incorporated (HTI), the company that provided the equipment for that study, and corresponded with the Bruce Ransom, the HTI Program Manager who recalled working with TransCanada's consultant on that project. Mr. Ransom noted that the 2009 study was restricted to a set-up with transducers located only behind the trash racks (due to the objective of determining entrainment into the turbine units), and utilized wide beam transducers that resulted in significant backscatter (noise). He further noted that the transducers were mounted on fixed, non-adjustable mounts that did not allow for transducer adjustment to achieve a cleaner signal. Mr. Ransom's email response included the following statements: "there are better ways to instrument and hydroacoustically monitor shad...at Vernon Dam;" "One could resolve passing juvenile shad in-turbine with the transducer array deployed at Vernon in 2009, although only in certain bands;" "The Vernon 2009 results aren't indicative of hydroacoustic sampling capabilities at the site;" and "With a sufficient deployment and testing period, proper transducer selection and placement, and probably incorporation of rotators to refine optimal aiming angle post deployment, we feel that one could do a good job of monitoring downstream shad entrainment from behind the trash racks at Vernon Dam..." These statements indicate that despite the disappointing results of the 2009 study, properly deployed hydroacoustic transducers would provide quality data to address the study objectives. We note that as part of their relicensing studies, FirstLight is proposing installation of hydroacoustic equipment at Cabot Station and the canal Gatehouse at the Turners Falls Project and at the Northfield Mountain Pumped Storage intake to assess juvenile shad outmigration. The goals and objectives of those studies are the same as the goals and objectives of this study at Vernon.

The use of a camera(s) has been proposed by TransCanada in lieu of a hydroacoustic study. However, a camera mounted on the bypass entrance has potential drawbacks due to the inability to discern images during periods of reduced visibility from turbid conditions. Hydroacoustic imaging can function in turbid conditions. Also, the field of vision for a single camera does not compare to the area of coverage that can be provided by acoustic transducers that can effectively create a detection screen. Juvenile shad outmigration is believed to be triggered by higher flow events, which are associated with high turbidity. As we noted at the May 23, 2013 meeting, hydroacoustic technology would also be of use in assessing silver eel outmigration study objectives (timing, duration, magnitude) as that period overlaps with juvenile shad. Analyses of hydroacoustic data would substantially improve our understanding of project impacts and inform any potential mitigative measures.

The Service supports the addition of 150 study fish to evaluate a Francis turbine unit as we had requested at the May 23, 2013 meeting. Turbine mortality/survival studies with tagged juvenile shad proposed to be conducted at full or near full generation. However, turbine mortality varies with turbine unit generation and efficiency. Therefore, the Service believes that if the units will operate at less than full hydraulic capacity, that is the condition that needs to be evaluated. Likewise, if the units are always operated at peak efficiency, those conditions should be evaluated. If the units are operated over a range of efficiencies, all conditions should be evaluated (maximum gate, peak efficiency, and minimum gate).

All data used to develop the report should be made available to stakeholders (upon request) in digital format, including all telemetry and other data.

Updated Study 23 - Fish Impingement, Entrainment, and Survival Study

Existing Information and Need for Additional Information

While TransCanada cites a number of passage route entrainment studies, it should be noted that, with the exception of one study by Normandeau (1996), the focus of all of the other studies was on a single species: Atlantic salmon.

Methods

TransCanada proposes to use existing literature along with the site-specific design characteristics of the turbines at the Wilder, Bellows Falls and Vernon projects to estimate potential entrainment rates and mortality of resident and diadromous fishes of interest. During the May 23, 2013 study plan meeting, the Service voiced concern over using this methodology, for the following reasons:

- While there is a database of turbine passage survival studies, the actual number of sites with similar design characteristics (e.g., turbine size, type, runner diameter, head, etc.) where similar target species were evaluated likely is quite small. For example, below is a table showing the number of sites available for comparison in the Electric Power Research Institute database. Once the evaluated species are compared with potential species of interest at the TransCanada projects, it becomes apparent that any mortality estimates derived from the literature would be based on a very limited data set.
- A recent report by Kleinschmidt (2007) [that used a methodology at the Holtwood Project (FERC No. 1881) similar to the one that is being proposed in the current updated PSP] found that the average predicted survival values derived from the Advanced Hydro Turbine Model (Franke *et al.* 1997) were higher than actual empirical studies conducted at the Holtwood Project for juvenile Alosids. Where empirical data were taken from other projects, results showed a higher survival for some species/life stages evaluated than from the modeled results (for adult river herring and adult eels). Where empirical studies showed lower survival than modeled results, Kleinschmidt appears to attribute the discrepancies to flaws in the field studies, while results showing higher survival in the field studies are attributed to differences in turbine specifications (rather than to any inherent flaws in the Franke *at al.* model). The Service acknowledges that field studies rarely are conducted under perfect conditions,

however it is equally plausible that the Franke *et al.* model requires further refinement that additional empirical studies may help inform.

While the Service does not object to using a desktop methodology to estimate turbine mortality at the three projects for resident fishes, we had recommended at the May 23, 2013 meeting that the results of the empirical mortality studies to be conducted on juvenile shad and adult eels be compared to estimates derived using the Franke *et al.* model. This comparison should allow further insight into the appropriateness of using a model, an off-site empirical study, or a site-specific empirical study to estimate turbine mortality at a project. In the updated PSP, TransCanada has adopted this recommendation.

Table summarizing pertinent turbine specifications for projects where survival studies have been conducted on Francis turbines, along with information from Vernon and Wilder.

Station	Designed Turbine Flow (cfs)	Number of Buckets	Runner Speed (rpm)	Head (ft)	Runner Diameter (in)
Vernon, Units 1 (vertical)	**3670**	**??**	**85.7**	**57**	**??**
Wilder, Unit 3 (vertical)	**700**	**??**	**212**	**58**	**??**
Alcona, MI	615	16	90	43	100
Alcona, MI	1155 -1660	16	90		100
Bond Falls, MI	450		300	210	
Caldron Falls, WI (Unit 1)			226	80	72
Centralia, WI (Unit 1)	510				
Centralia, WI (Unit 2)	510		90	20	28
Centralia, WI	variable			15.5	
Colton, NY	497	19	360	265	59
Cushman Plant 2, WA	800	17	300	450	83
Cushman Plant 2, WA (1960)	800	17	300		83
E. J. West, NY	2,700	15	113	63	131
Finch Pruyn, NY (Unit 4)				9-16	41
Finch Pruyn, NY (Unit 5)				9-16	41
Five Channels, MI	675	16	150	36	55
Five Channels, MI	1034 -1167	16	150		55
Grand Rapids, WI (U 1,2,4 comb)	645		90		
Grand Rapids, WI (Unit 2)	645		150	28	58
Grand Rapids, WI (Unit 4)	926		180	28	72
Hardy, MI (Unit 2)	510	16	163.6	100.2	83.75
Highley, NY	675	13	257	46	48
Hoist, MI	300		360	142	
Holtwood, PA(U10/single	3,500	16	94.7	62	149.5

runner)					
Holtwood, PA (U3/double runner)	3,500	17	102.8	62	112
Holtwood, PA	3,500	16	95	55	164
Luray, VA	369	12	164	18	62.75
La central de Beauharnois	7,000	13	75	79	212
Minetto, NY	1,500	16	72	17	139
Peshtigo, WI (Unit 4)	460		100	13	80
Potato Rapids, WI (Unit 1)	500		123	17	84
Potato Rapids, WI (Unit 2)	440		135	17	80
Pricket, MI	326		257	54	53.5
Rogers, MI (units 1 & 2)	383	15	150	39	60
Ruskin, BC	4,000		120	130	149
Sandstone Rapids, WI			150	42	87
Seton Creek, BC	4,500		120	150	114
Shasta, WA	3,200	15	138.5	380	184
Shasta, WA	3,200	15	138.5		184
Stevens Creek, SC	1,000	14	75	28	135
Vernon, VT/NH	1,834	15	74	34	156
White Rapids, WI	1,540	14	100	29	134
White Rapids, WI	900				
Youghiogheny, PA	750			120	

Updated Study 24 – Dwarf Wedgemussel (*Alasmidonta heterodon*) and Co-occurring Mussel Study

The updated PSP for DWM has further clarified study methods and analyses to address the issues that were discussed that the study plan meeting on June 6, 2013. While it is understood that methodologies to answer the question of the projects' impacts on DWM are somewhat experimental, the updated PSP does a good job of laying out the sequence of data collection and consultation on next steps and study alternatives.

Updated Study 25 – Dragonfly and Damselfly Inventory and Assessment

We defer comment on this study to the Vermont Agency of Natural Resources.

Updated Study 26 – Cobblestone and Puritan Tiger Beetle Study

We have no comments on this study plan.

Updated Study 27 – Floodplain, Wetland, Riparian, and Littoral Habitats Study

Methods

Invasive Plant Species

At the June 6, 2013 study plan meeting, the Service questioned whether the entire shoreline would be mapped for invasive species. In response, TransCanada noted that during the 2010 erosion survey, invasives data were collected. Service staff stated that, based on the level of detail presented in the Pre-Application Document, it was unclear what types of invasives data were collected in 2010 (were dominant species identified? did the geo-spatial documentation allow for a quantification of infestation?). In response to these concerns, TransCanada has updated the plan to specify that well-defined beds of invasives would be revisited, mapped with GPS, and characterized. The Service supports these changes, as it will allow for a more informative assessment of invasives throughout the project-affected areas.

Analysis

For the bald eagle information, we recommend that the report provide maps of the project area showing locations of all eagle roosting and nesting trees. A complementary table should be provided listing the location of the trees, whether it is a roosting or nesting site, an assessment of its status (healthy, diseased, etc.) and its level of protection (e.g., within a right-of-way, on protected/conservation land, etc.).

Updated Study 28 – Fowler's Toad Survey

We defer comment on this study to the Vermont Agency of Natural Resources.

Updated Study 29 – Northeastern Bulrush Survey

We have no comments on this study plan.

Thank you for the opportunity to comment on the updated PSP. If you have any questions regarding these comments, please contact John Warner of this office at 603-223-2541.

Sincerely yours,

Thomas R. Chapman
Supervisor
New England Field Office

cc: John Rangonese
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VERMONT

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FILED AND DISTRIBUTED ELECTRONICALLY

July 15, 2013

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

RE: COMMENTS ON UPDATED PROPOSED STUDY PLANS
Wilder Hydroelectric Project – FERC No. 1892-026
Bellows Falls Hydroelectric Project – FERC No. 1855-045
Vernon Hydroelectric Project – FERC No. 1904-073
Northfield Mountain Pump Storage Project – FERC No. 2485-063
Turner Falls Project – FERC No. 1889-081

Dear Secretary Bose:

The Vermont Agency of Natural Resources (Agency) herein provides comments on the proposed study plan developed by TransCanada Hydro Northeast, Inc. (TransCanada) for the Wilder (FERC No. 1892), Bellows Falls (FERC No. 1855), and Vernon (FERC No. 1904) projects. TransCanada filed its proposed study plan on April 15, 2013 followed by six full-day meetings between May 13, 2013 and June 7, 2013 to received comments and recommendation from the resource agencies and other stakeholders. On June 20, 2013, TransCanada submitted a document to the resource agencies and stakeholders summarizing the comments and suggestions received during the meetings and stating whether or not they would be incorporated in the revised study plan. TransCanada filed a revised proposed study plan on July 8, 2013 with FERC. The Agency's comments are on the June 20, 2013 summary document and the July 8, 2013 updated proposed study plan.

The Agency also is providing comments on the proposed study plan developed by FirstLight Hydro Generating Co. (FirstLight) for the Northfield Mountain Pump Storage (FERC No. 2485) and Turners Falls (FERC No. 1889) projects. FirstLight filed its proposed study plan on April 15, 2013 followed by eight full-day meetings in which representatives from the Agency participated to give comments and recommendations on the study plans. FirstLight filed an updated study plan with FERC on June 28, 2013. Although the two projects are located on the Connecticut River in Massachusetts, project operations fluctuate flows and water levels in the Turners Falls impoundment, affecting about 5.7 miles of Vermont waters between Vernon dam and the Vermont/Massachusetts boundary. These operations may influence migratory fish species that must move upstream past these projects to reach habitat in Vermont, move from Vermont waters downstream past the projects, or both. Fish such as American shad and American eel use Vermont waters (Connecticut River and its tributaries) as part of their life cycle, and must be able to migrate to these waters from ocean habitats and then return. Other fish species such as walleye, brown trout and other species also move upstream and downstream to meet seasonal habitat needs, such as to find spawning habitat, over-wintering habitat, feeding areas or more favorable temperature conditions.

These movements may be localized or may involve miles of travel, but they are very important to production and survival. The Agency's comments on the study plan reflect these concerns and we request that FERC recognize the Agency's interest in these projects and take into consideration our comments and suggestions.

General Comments:

FERC's Scoping Document 2 states that the Turners Falls impoundment extends to the base of the Vernon dam. During the study plan meetings held in May and June, FirstLight stated that its hydraulic model indicates that the impoundment does not extend to the base of Vernon dam, but ends at a point downstream. TransCanada has subsequently included the reach downstream of the Vernon dam in the study area in all relevant study plans. The Agency requests that FirstLight provide information on the operation of its projects so that the frequency, duration, and periodicity of conditions when the Vernon discharge has a significant influence on this reach of river can be fully understood. This information is necessary for the Agency to evaluate seasonal flow requirements to protect aquatic biota and habitat downstream of Vernon dam.

In general TransCanada and FirstLight have attempted to incorporate the Agency's comments and suggestion in their revised study plans, but issues remain. The Agency's comments for TransCanada (Attachment A) and FirstLight (Attachment B) are attached.

Thank you very much for considering our comments.

Very truly yours,

Brian T. Fitzgerald
Streamflow Protection Coordinator

Attachments

c: Shannon Morrison, Department of Environmental Conservation
Marie Caduto, Department of Environmental Conservation
Lael Will, Department of Fish and Wildlife
Rod Wentworth, Department of Fish and Wildlife
Robert Popp, Department of Fish and Wildlife
Eric Sorenson, Department of Fish and Wildlife
Mark Ferguson, Department of Fish and Wildlife
John Warner, U.S. Fish and Wildlife Service
Melissa Grader, U.S. Fish and Wildlife Service
Gregg Comstock, N.H. Department of Environmental Services
Owen David, N.H. Department of Environmental Services
Gabe Gries, N.H. Fish and Game Department
Caleb Slater, MA Department of Fish and Game
Kevin Mendik, National Park Service
John Ragonese, TransCanada
John Howard, FirstLight
David Deen, Connecticut River Watershed Council
Kim Greenwood, Vermont Natural Resources Council
Chris Moore, Trout Unlimited – Vermont Council

Attachment A
VANR Comments on TransCanada Proposed Study Plan

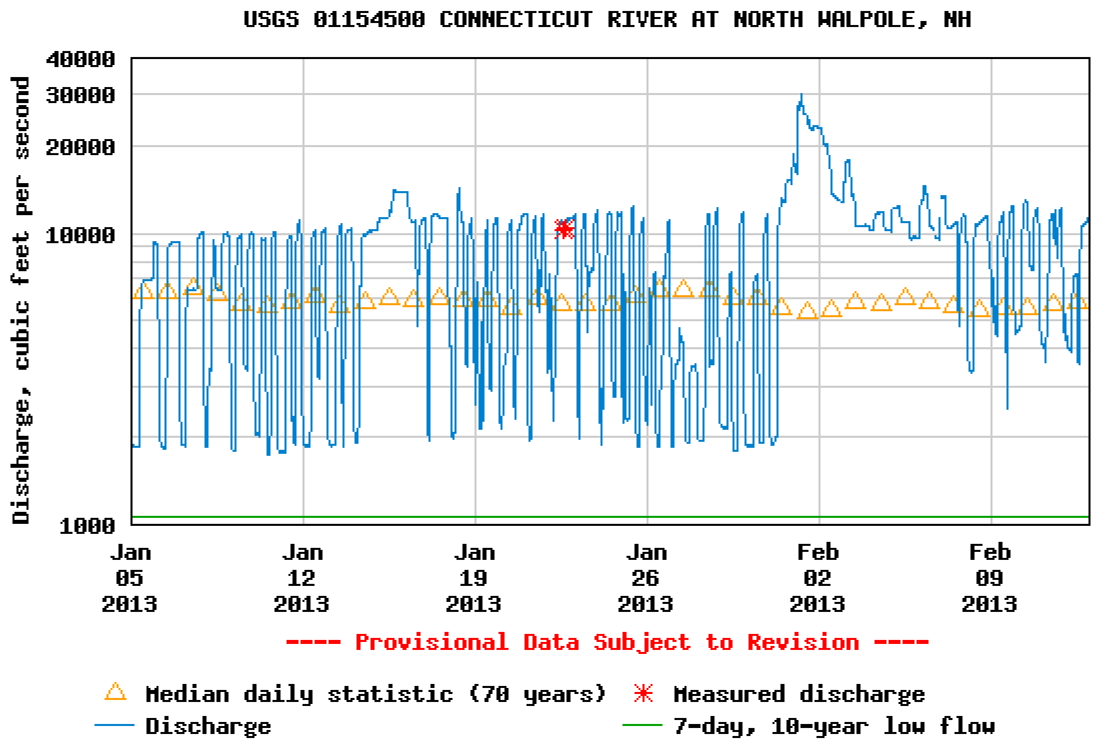
Study 1: Historic Riverbank Position and Erosion Study

The Agency requested a study to determine the historical extent of erosion along the Connecticut River to determine if the rate or type of erosion has changed or increased with changes in operational procedure at Wilder, Bellows Falls, and Vernon hydroelectric projects. TransCanada proposed study plan in the Analysis section (pg. 17) indicates that the licensee will try to correlate historic bank loss to a specific period or time frame, historic hydrological events, or other causal agents. The Agency recommends that added to possible causal agents or specific periods when changes in operations occurred at the projects (i.e. increase operational capacity, change in impoundment elevation or management). Including this information in the correlation analysis will give the Agency a better idea of how project operations potentially are affecting the rate and type of riverbank erosion on the river.

Study 2: Riverbank Transect Study

The objective of the Agency's study request was to monitor riverbank erosion at selected sites in the impoundments and project-affected riverine sections below Wilder, Bellows Falls, and of Vernon dam. In the Agency's study request addressing riverbank erosion from water level fluctuation in the impoundment and downstream from peaking operations, the Agency requested that the study determine the process by which erosion is occurring at a site, determine the process causing erosion at a site, the extent erosion is negatively affecting other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.), and determine how erosion could be stabilized or mitigated by changing project operations. In order to evaluate the relative influence of water level fluctuations on existing shoreline erosion, a minimum of six select sites (three in the impoundment and three downstream of the dam) for each project was requested. The Agency also requested that surveys be conducted biweekly for a period of one year, at each of the 18 sites. However, the licensee is proposing that surveys will occur at least four times per year for 2 years, including immediately after high spring flows, early and late summer, and then in late fall with additional surveys conducted within 15 days of any significant high water event (monitoring trigger flow to be determined after review of exceedance curves of natural inflows). In their study plan, the licensee states that the additional monitoring is not incorporated into this study as such information will only be valuable if active soil loss occurs nearly continuously throughout the year. Therefore, the licensee is assuming that erosion is not occurring continuously as a result of daily peaking operations and water level management in the impoundments.

Monitoring more frequently would provide a control (look at things in the absence of high flow events), and continuously because flow and water level fluctuations on a daily basis could slowly cause erosion to occur. The Agency also recommends that the study plan include monitoring in the winter season because of the relationship between ice scour and daily fluctuations in flow and water level. Additionally, the licensee states in the method section of the proposed study plan under the sub-heading of Surface Water Level Monitoring (pg. 23) that "Flow variation is generally limited in the winter months, so the absence of data collection in the winter months should not alter study results." The streamflow data from the USGS gauge located in North Walpole, NH below the Bellows Falls project for winter 2013 indicates that water level fluctuations associated with project operations happens on relatively the same periodicity as in other seasons (See hydrograph below). The Agency does not agree that absence of this data collection will not alter study results. The licensee study plan should indicate how they will address water level fluctuation in the winter and how it could potentially affect riverbank erosion.



In their "TC study Meeting comments and action items -2013 06 20.doc" the licensee did provide considerations in regards to changing the monitoring frequency. The Agency requests that the licensee increase their monitoring frequency to the biweekly schedule as proposed.

<table>
<tr><td colspan="2">E. Erosion Monitoring: Consider changes in proposed monitoring frequency due to observations of rapid erosion or based upon event triggers (high runoff events, ice scour, spring freshet). Identify and characterize events historically, frequency; if possible tie events to erosion observations or noted changes in morphology.</td></tr>
<tr><td>Describe plan for how to proceed with more details where rapid erosion is identified, need to identify added cost.</td><td>Will consider pending evaluation.</td></tr>
</table>

Study 3: Riverbank Erosion Study

The proposed study plan largely meets the Agency's requirements and we do not have any additional comments. The Agency will work with the licensee and provide input and feedback as describe in the updated study plan.

Study 4: Hydraulic Modeling Study

The proposed study plan largely meets the Agency's requirements and we do not have any additional comments. The Agency will work with the licensee and provide input and feedback as describe in the updated study plan.

Study 5: Operations Modeling Study

The Agency's study request specifically requested that a model be developed to look at climate-altered flows on project operations over the course of the license. The licensee's proposed study plan currently does not address this objective. The proposed model will model project operations in five non-consecutive years selected from the past 30 years ranked from driest to wettest. This approach does not capture how project operations and river flows will be affected during consecutive wet or dry years. Additionally, the model does not capture any extreme climate and precipitation events that are predicted to increase in frequency with the onset of climate change, and how these will impact project operations or energy production. In other words, if extreme precipitation events increase in frequency resulting in more frequent tripping of the stanchion bays at the projects will be addressed. The Agency request that the licensee address the issue of climate-altered flows on project operations over the course of the license so that the Agency can better assess the potential impacts on the river ecosystem and water quality from project operations.

Study 6: Water Quality Monitoring and Continuous Temperature Monitoring

The licensee has proposed in their study plan to continuously monitor temperature from June 1 through September 30. The Agency requested that continuous temperature monitoring be done from April 1 through November 15 or when conditions are safe for the field crew to deploy the temperature loggers. The original request was that the temperature loggers be deployed in the upper, middle, and lower part of the impoundment and an additional transect located in the free flowing section of the river above the each impoundment to serve as a reference. The continuous monitoring of temperature during this time it is an important factor in determining the effects the projects impounding water on a daily basis are potentially having on the timing of migratory fish runs and spawning. The rationale for the for extending the time period for continuous temperature monitoring is the spring and fall is typically when the fish ladders are open at each of the projects and riverine and diadromous fish are actively moving through project ladders and impoundments. Temperature is an important variable in determining the timing of fish migration and spawning. Therefore to understand how project operations affect river temperature and whether they are being altered, possible causing delays during the spring and fall runs and out migration when fish are most actively moving through the project area is important.

Additionally, the Vermont Water Quality Standards state that the change in temperature either upward or downward shall be controlled to ensure full support of aquatic biota and habitat use, as well the Connecticut River managed as a cold water fish habitat and shall not exceed 1.0°F from the ambient temperature due to the activities from the project. The Agency needs to understand how temperature of the river is being potentially affected by project operations in the spring and fall to understand how it might impact the fisheries and aquatic habitat use and timing and possible delays in fish migrations. If potential delays in fish migrations are occurring from project operations effect on temperature, the Agency reserves the right to request a more detailed study in the second year of on the temperature within the impoundments at any of the projects.

Study 7: Aquatic Habitat Mapping

The goal of this study is to survey, identify, and map aquatic habitat at the Wilder, Bellows Falls, and Vernon Project-affected areas and assess potential effects under current operations. TransCanada is proposing to collect supplemental temperature data during this study using Onset Hobo water level loggers and temperature loggers opposed to the Agency's request it the water quality study request that continuous temperature at transects located in each of the impoundments that would be collected from April 1 to November 15. In the revised study plan it is unclear if TransCanada is proposing to leave the water level and temperature loggers at the sites identified from April 1 to November 15. The licensee needs to clarify in its study plan how the duration the water level and temperature loggers will be deployed.

Additionally, the licensee is proposing to validate classifications of all habitat types from side scan imagery via visual assessment within shallow water habitats and/or clear water conditions as well as pole and ponar grab samples for deeper water areas. In order to quantify the composition of substrates collected from the ponar grab, the Agency recommends that samples be brought back to the lab for further analysis. Percent composition by weight using the modified Wentworth scale would provide additional information on the aquatic benthic habitat, and would not require much more effort.

Additionally the Agency agrees with the licensee's proposed revisions as described below.

<table>
<tr><td colspan="3">A. Note in the SP as to the ability or desire to perform the bathymetry mapping at the highest pond possible.</td></tr>
<tr><td></td><td>Consult with TC Operations and determine the extent possible for summer 2013.</td><td>SP Revised.
We will attempt to do this based on flow/elevation changes and timing, and rain events.</td></tr>
<tr><td colspan="3">B. Provide clarity and criteria for adjusting and collecting 1-foot contour bathymetry when depths are 10 feet or less from top of reservoir max elevation, regardless of whether along edge or in center of river (i.e., islands).</td></tr>
</table>

	Revise SP	SP revised and clarified, but not exactly as requested/commented upon. We propose 1-foot intervals in water depths of 10 feet or less (as measured from the full pond water surface elevation regardless of their spatial location (i.e. littoral edges of impoundment, mid-impoundment island areas, etc). All sections of the impoundments where pool depths are greater than 10 feet from the full pond water surface elevation will be collected at 2-foot intervals. These contour intervals will provide sufficient detail to assess the potential effects of reservoir fluctuations associated with project operations on aquatic habitat. The full operating range for each project is as follows; Wilder: 380.0’ to 385.0’ msl (5 feet), Bellows: 288.6’ to 291.6’ msl (3 feet), and Vernon: 212.0’ to 220.0’ msl (8 feet).
C. Provide greater clarity on substrate sampling methods, techniques; particularly in the deeper areas associated with downstream (riverine) reaches. (drag chain, copper pole methods suggested)		
	Revise SP	SP Revised
D. Note in the SP as to the ability or desire to perform the bathymetry below the dams (in riverine section) during low flow conditions, for the purpose of mapping the transition area from riverine to impoundment.		
	Consult with TC Operations and determine the extent possible for summer 2013.	SP Revised Statement added to address this in the first paragraph of the methods. Note that bathymetry is not the appropriate technique for riverine sections. See response to G below.
E. Provide more detail on accuracy of instruments, bathymetry sounding equipment. Provide more description on QA/QC methods and control.		
	Revise SP	SP Revised Added detail to QC habitat methods Added bathymetry QC detail to methods section along with reference to NOAA survey guidelines being followed

<table>
<tr><td colspan="3">F. Consider methods to assure coverage of so-called transitional zones (areas impacted by impoundments and discharge – sometimes exclusively and other time concurrently). Expressed desire to map under impoundment conditions (high pond) and map as riverine (low flows).</td></tr>
<tr><td></td><td>Consult with TC Operations and determine the extent possible for summer 2013.</td><td>SP Revised as noted above</td></tr>
<tr><td colspan="3">G. Deeper areas in the riverine habitats below the dams may require additional methods to acquire bathymetry. Please identify methods that will be considered as well as those that cannot be used and explain merits or issues associated with each. Identify criteria or decision making (when and why) that will drive the decision to use a particular method.</td></tr>
<tr><td></td><td>Identify options – both the positive and negative aspects of each.</td><td>SP clarified

Bathymetry was limited to the impoundment sections as the equipment to conduct that work needs to be mounted on an appropriate survey vessel and should not be bouncing around in riverine sections with limited access and/or shallow water obstacles.

Mesohabitat mapping will be conducted as part of the instream flow study (#9) and this work will occur in the riverine sections.</td></tr>
</table>

Study 8: Channel Morphology and Benthic Habitat Study:

The Agency requested a study to determine the potential for projects to affected fluvial processes related to movement of coarse sediment and the potential effects on benthic habitat. In TransCanada's proposed study plan in the Study Area and Study Site Section (pg. 100) as proposed for study sites that are located below each of the projects to use a site at the head of the impoundment downstream as it will be a representative riverine reach of the upstream project and the impoundment. The Agency does not agree with this assumption because the sites will not representative of the affects from the dam. The riverine site should be located closer to dam and before any major tributaries enter the river to be representative of the dams' impact on benthic habitat conditions. The Agency recommends that the study plan be amended to include study site just downstream of the dam.

Study 9: Instream Flow Habitat Study:

The study plan specifically mentions minimum flows in several locations. We want to be clear that the Agency is concerned about the entire flow regime (magnitude, frequency, duration, timing and rate of change). The objective of the instream flow study is to quantitatively assess the relationship between flow and aquatic habitat for selected target organisms so that the flows needed to provide suitable habitat conditions can be determined. This will involve consideration not only of seasonal conservation flows (formerly known as minimum flows) but of maximum flows and when they occur, how often, and the transition rate. And, the ecological implications of locational shifts in suitable habitat with flow must also be assessed.

In its scoping of instream flow studies, the Agency typically focuses on riffle reaches. Riffle areas are the most sensitive to flow changes and are also critical to the stream's ecological functions. A flow regime that is adequate for riffle areas is likely to satisfy the needs for food production, fish passage, spawning and rearing. Other habitat types (runs, pools) will also be protected since they are less sensitive to flow changes. Fluvial-dependent species and life stages that utilize riffle habitats are then included among the target organisms.

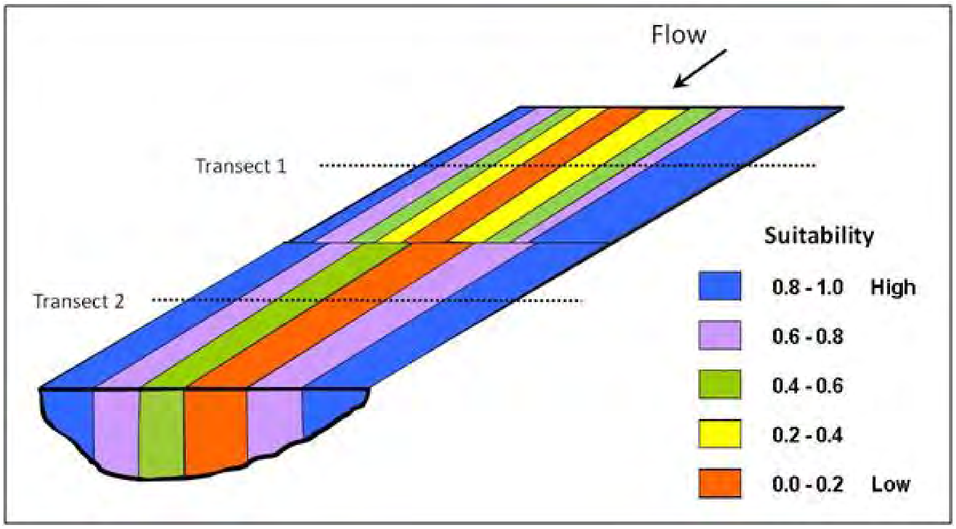
The Connecticut River includes a large quantity of impounded, relatively deep habitat with slow moving water. The instream flow studies should focus on organisms that require flowing water conditions and the corresponding habitats.

The study plan calls for the inclusion of transects in all mesohabitat types. While we do not object to this, we do have concerns over how the information is used. For example, data from riffles, pools and runs should not be combined for analysis as this masks the effects on the most sensitive areas by pooling them with less affected habitats. We consider riffles to be critical habitat which should be studied using what is sometimes called a "critical reach" approach. Ultimately, a flow regime that provides suitable habitat conditions in riffles must be provided.

As was pointed out by TransCanada's consultants during the study plan review meetings, 2-D hydraulic modeling covers a specific reach of river since it uses a special grid network of data points instead of transects. Such a study reach could include more than one mesohabitat type. The Agency recommends that 2-D study reaches be selected based on the principles described above.

The species and life stages to be assessed (target organisms) should also focus on those that require or utilize flowing waters, as opposed to generalists such as yellow perch that also live in lake environments. The inclusion of early life stages is particularly important as flow-related habitat bottlenecks often occur at these stages. The details for the selection of target organisms and habitat suitability criteria should be resolved in consultation with the study working group members.

The Agency is pleased that TransCanada has included a dual flow analysis in its revised study plan, as part of the assessment of the effects of hydropeaking. The Agency recommends that the study also include graphics (sometimes referred to as habitat maps; not to be confused with the Aquatic Habitat Mapping Study 7) that show categorized PHABSIM cell suitabilities for selected flows. These graphics (see 1-D example below) clarify where in the river habitat exists, as well as its quality, and what shifts in location may be occurring. They are helpful in interpreting the dual flow results.



The Agency recommends that dual flow results be presented not only as a matrix of values, but also graphically, as shown in the following references.

Milhous, R.T. 1992. Determining the minimum flow below hydro peaking projects. Hydro Review 11(6):67-74.

Conners, M.E. and J. Homa Jr. 1992. Presenting dual flow modeling results for flow alternatives analysis. Instream Flow Chronicle II(3):1-3.

Additional details for these analyses should be resolved in consultation with the study working group members.

The study plan includes a section on “Time Series and Hydrology” that implies that this analysis will be done using habitat duration curves. A habitat time series combines a hydrograph and habitat-flow relationship to produce a graph showing habitat as a function of time. The Agency believes that this type of analysis is more useful than duration curves, especially in hydropeaking situations. However, it is necessary to carefully select the hydrologic data set (year), time step, time of year, target organisms and operating scenarios to be compared. These determinations should be made by the study working group and based on the steady state habitat results.

Study 10: Fish Assemblage Study:

The goal of this study is to determine the occurrence, distribution, and relative abundance of fish species present in the project-affected areas. The proposed methods include electrofishing (boat, pram, and backpack) and gill netting with experimental nets. Fish assemblage studies typically employ a multi-gear approach as shown in the following reference.

Bonar, S. A., W. A. Hubert, and D. W. Willis, editors. 2009. Standard methods for sampling North American freshwater fishes. American Fisheries Society, Bethesda, Maryland. 335 pages.

The Agency recommends that sampling methodologies include a multi-gear approach and are consistent with the American Fisheries Society's national standards as referenced above.

The licensee should also should consider employing a benthic trawl (as will be used in Study 12), in order to target deep water benthic habitat. The Agency recommends that the licensee employ a stratified random sample design to capture the spatio-temporal variability. The sampling sites should be stratified by habitat type, depth of water, day or night (or time of day), as well as distance from the dam, and season (spring, summer, fall).

The licensee proposes that for experimental gill nets; "Nets will be set and allowed to fish for a 24-hour period prior to pulling." The Agency recommends that the nets soak for no more than two hours per set, as soaking for a 24-hr period will cause significant mortality.
The licensee proposes to collect water quality data at the time of sampling. Parameters include temperature, DO, pH, and conductivity. The Agency recommends that turbidity also be included as a parameter because high turbidity will affect the visibility (and hence catch rate) during electrofishing. Studies have also shown that high turbidity reduces the ability of fishes to see the trawl net during benthic trawling. This may also affect catch rates.

The Agency agrees with the licensee's proposed study plan revisions as described below.

A. Suggest standard sampling methodology (VANR gave reference to refer to) for future comparison, randomized/replicate sampling at each location. Goal to improve ability to draw inference and reduce sampling error.		
	Will review the reference. We use EPA standardized method. We will look for any updates in that protocol also.	SP Revised. SP revised for methodology.
B. Consider randomized/replicate sampling at each location. It is better to have data to draw inference on. Reduces sampling error. [K Kennedy]		
	Will consider	SP Revised. SP has been updated to reflect this approach – see response to comment A
C. Beneficial to have analysis incorporate size category, and a measure of variance in that. Requests coefficient of variation to compare across different gear types. CV < 20 are desirable.		
	Revise Study Plan	SP Revised.
D. Include turbidity in WQ data collection and specify time of day for electrofishing (or include time of day as a covariant)		
	Revise Study Plan	SP Revised.
E. Specify the time of day or night for each sample and be sure to include it as a co-variant in the analysis.		
	Revise Study Plan	SP Revised. see response to D
F. Include turbidity in the WQ sampling at each sample location		

<table>
<tr><td></td><td>Revise Study Plan</td><td>SP Revised.
see response to D</td></tr>
<tr><td colspan="3">G. 2 hour gill sets at night are preferable to the proposed 24 sets – to reduce "fish gilling" mortality or injury. FL using trapnet for deeper water. Trawl for deeper waters similar to darter sampling we propose.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>SP Revised.

SP revised to rely on 2 hour gill net sets. These will be done at night to increase likelihood of catch. 2 hour sets will reduce mortality and satisfy the VT fisheries request to do so.

Study 10 will rely primarily on boat electrofish with supplemental gill/trap netting. We are not proposing additional trawl sampling but will incorporate results from Study 12 (darter trawling)</td></tr>
<tr><td colspan="3">H. Review study requests for methods (gear), temporal variation (day or night) etc.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>SP Revised.
Clarified methods section to explain gear use including conditions that must be met to use a particular type of gear and what time of day that gear would be used.</td></tr>
<tr><td colspan="3">I. Specify electrofishing locations particularly with respect to setbacks and side</td></tr>
<tr><td></td><td>Revise Study Plan; Clarify and provide detail as needed</td><td>SP Revised.
Revised methods section to provide more detail on fish sampling in setbacks vs. mainstem areas</td></tr>
<tr><td colspan="3">J. Eagles –if using trapnets, consult w/ FWS on gear types and impacts on eagles. Get a permit for activities. Would gill netting also be a concern? Probably not if at night.</td></tr>
<tr><td></td><td>If use of trap nets are specified, address this and revise Study Plan</td><td>SP Revised.</td></tr>
<tr><td colspan="3">K. Think through on study design to be sure it meets variety of goals, methodology, data collection, temporal etc., gear types to develop sampling design.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>SP Revised.
See comment A. Following discussion with Katie Kennedy and review of FL plan and associated references have modified our approach.</td></tr>
<tr><td colspan="3">L. Is there sampling in the setbacks or just mainstem? If so, specify method. Fyke nets may be appropriate method in those locations. Clarify in plan</td></tr>
<tr><td></td><td>Clarify sampling in setbacks and shallows; specify method in plan.
Consider sampling in locations even if not</td><td>SP Revised.
Setbacks that occur within one of our randomly selected segments will be</td></tr>
</table>

	fluctuating enough to impact spawning (in that study).	sampled to the point that equipment can operate and area is still within the influence of project operations.
M. Capture assemblage below Vernon Dam		
	Revise plan to sample below Vernon to a location just below Stebbins Island. Utilize any VY data available	SP Revised. Added an additional stratum (Vernon to DS end of Stebbins Island (1.5 miles)). Will be sampled following same methodology used in other locations. Will need to review publically available VY data as part of study (SP not yet revised).
N. Commit to a repetitive study year or season if conditions are abnormal? ***[K Kennedy] – one way around those drawbacks (e.g. drought) is to sample outside of the project to reflect "natural" conditions and not on the project.***		
	We will rely on ILP regulations for anomaly conditions requiring additional year, as applicable to all studies.	No changes in SP, consultation will be ongoing for all studies. Progress reports and study reports will be prepared and shared for comment.
O. Need scientific collecting permit from VT F&W for fishing in VT water. Also in NH		
	Specify in SP that we will secure all necessary permits for study	SP Revised. Sentence added to plan in Schedule section

Study 11: American Eel Survey:

The goal of this study is to provide baseline data relative to the presence of American eel upstream in the project-affected areas. In the Agencies study request, the objective of the study was to determine the relative abundance and distribution of American eel upstream of the Vernon, Bellows Falls and Wilder dams in both riverine and lacustrine habitat. The Agency requested an eel survey be conducted in the mainstem river and tributaries upstream from the three projects. In general, a combination of electroshocking (backpack in wadeable rivers and boat-mounted in larger rivers and lakes) and eel pots should be used to collect eels and determine catch rates. Sampled habitat should include: the mainstem Connecticut River from upstream of Vernon Dam to below the Dodge Falls project located in Ryegate, VT; tributaries to the Connecticut within that stretch where eels have been collected previously; and lakes and ponds (such as, but not limited to, Spofford Lake and Lake Morey), where eels have been collected previously. Sampling should occur during the summer (July through September).

However, the licensee is only proposing to sample in the project waters upstream of each dam from the upper extent of Wilder impoundment downstream to Vernon dam stating the reasons for not conducting survey for eels in lakes and ponds because these areas are outside the FERC designated project areas and have no nexus with the project operations. FERC guidelines on developing study criteria for the ILP process indicates that a FERC project boundary is not appropriate in limiting the geographic scope of studies and the geographic scope should be determined by the effects of the project on the resource in question. American eels migrate out of the Connecticut River watershed to the Sargasso Sea to spawn. Eels are known to occur within lakes, ponds and tributaries located above and outside the project-affected areas. In order for the Agency to assess the need to provide downstream fish passage for eels the relative abundance of the number of eels above each project is needed. As currently designed, the study will yield an underestimate of the eel population and will not be sufficient for assessing the need for downstream passage. Therefore, downstream passage prescriptions should not be based on these results.

The Agency recommends that a watershed survey should be done to provide data for passage prescriptions because all eels will have to pass through the projects in order to migrate to the ocean. The Agency does not agree with the licensee's response to limit the study scope to the mainstem.

The Agency would be willing to collaborate with the licensee to obtain more representative estimates. For example, if the licensee were to tag yellow eels and monitor within project affected areas, the Agency would be willing to take over and monitor/and or sample throughout the tributaries and ponds. These data would provide more robust results.

Setting up Hydroacoustics array at Vernon would support this study, and should be considered.

Study 12: Tessellated Darter Survey:

The goal of this study is to characterize the distribution and relative abundance of tessellated darter within project-affected areas. The Agency recommends that trawling methods be consistent with section 5.3.3 from the following reference.

> Bonar, S. A., W. A. Hubert, and D. W. Willis, editors. 2009. Standard methods for sampling North American freshwater fishes. American Fisheries Society, Bethesda, Maryland. 335 pages.

The Agency also recommends that turbidity measurements be taken at the time of sampling because studies have shown that as turbidity increases the ability for fishes to see the net decreases which could affect catch rates.

Study 13: Tributary and Backwater Area Fish Access and Habitats Study:

The goals of this study are to determine if water level fluctuations from project operations cause impediments to fish movement into and out of tributaries and backwater areas within the project-affected areas; and determine if water level fluctuations caused by project operations effect available fish habitat and water quality in the tributaries and backwater areas within the project-affected areas.

In the Agency's study request on the impacts of project operations on tributary and backwater area access and habitats, proposed methodology included collecting water quality information (dissolved oxygen, temperature, turbidity, and pH) within the tributaries and backwater areas because as water level changes is has the potential to alter water quality and quantity in these areas, which could decrease productivity or survival.

However, the licensee is proposing that during the first study year (2014), water level recorders (estimated 30 units total) will be placed in selected backwaters and tributary areas and will operate for an entire year to collect hourly depth changes and water temperature. Additional water quality data will only be collected in these areas (temperature, DO, pH, conductivity, and turbidity) if it is found that access to the main river is impeded. However, the Agency requests that water quality be monitored at a randomly selected subset of the 22 setback areas, because even if there is connectivity water quality may not be maintained.

The Agency requests that methods include a comparison of water quality between the mainstem and setbacks/tributary areas to establish relative differences between the two habitat types.

The Agency requests that a one-foot depth or less at the mouth of tributary or setback be the trigger for concerns relative to fish movement (i.e., depth barrier).

Study 14: Resident Fish Spawning in Impoundments Study:

The goal of this study is to assess whether project related water level fluctuation in the impoundments effect resident fish spawning. The proposed study plan will be conducted field surveys to assess potential effects of impoundment fluctuation on nest abandonment, spawning fish displacement, and egg dewatering. However, it is well known that the widened impoundments due to the dams replace riverine (lotic) habitats with a lake-like (lentic) environment. These impoundments serve as repositories for silt and sediments that cover natural gravel substrate that serve as spawning and habitats. Therefore, the Agency is requesting that the study investigate sedimentation, or the amount of fines within a nest (in addition to nest abandonment, spawning fish displacement, and egg dewatering) as a potential negative impact due to the project's impoundments and operations.

Study15: Resident Fish Spawning in Riverine Sections Study:

The goal of this study is to determine if project related water level fluctuations in the affected areas downstream of Wilder, Bellows Falls, and Vernon dams negatively affect resident fish spawning.

In addition to assessing potential effects of operational flows and water level fluctuations on nest abandonment, spawning fish displacement and egg dewatering, the Agency is requesting that the study assess nest scouring as a potential negative impact, as fluctuations in water levels and flow velocities from project operations could potentially cause scouring.

The Agency concurs with the licensee’s proposed study plan revisions as described below.

<table>
<tr><td colspan="3">A. Add detail on egg trap placement and sampling protocol; SP needs further definition. [is there a need for consultation with stakeholders?]</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>SP Revised.
Methods section edited to add more detail on egg trap construction and the criteria we will initially use to identify potential sampling spots.</td></tr>
<tr><td colspan="3">B. Include (study) “riverine” reach below Vernon in the resident fish spawning in riverine study.</td></tr>
<tr><td></td><td>Based on study meetings, all applicable studies will include approximately 1.5 miles downstream of Vernon dam to lower extent of Stebbins Island</td><td>SP Revised.
Includes downstream of Vernon approximately 1.5 miles</td></tr>
<tr><td colspan="3">C. Longnose Dace should be added to the list of species, if identified in part through the fish assemblage study.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>SP Revised.
added</td></tr>
<tr><td colspan="3">D. Salmonids should also be included; noting if and where spawning occurs.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>SP Revised.
added</td></tr>
</table>

Study 16: Sea Lamprey Spawning Assessment:

The goal of this study is to assess the level of spawning activity by sea lamprey (*Petromyzon marinus*) in the project-affected areas and to determine whether project operations are affecting the success (i.e., survival to emergence) of lamprey spawning. The Agency recommends that methods follow Chapter 8 in:

> Bonar, S. A., W. A. Hubert, and D. W. Willis, editors. 2009. Standard methods for sampling North American freshwater fishes. American Fisheries Society, Bethesda, Maryland. 335 pages and Gallagher, S.P, P.K. Hahn, and D.H. Johnson. 2007. Redd Counts. Pages 197–234 in D.H. Johnson, B.M. Shrier, J.S. O’Neal, J.A. Knutzen, X.Augerot, T.A. O’Neil, and T.N. Pearsons. Salmonid field protocols handbook: techniques for assessing status and trends in salmon and trout populations. American Fisheries Society, Bethesda, Maryland.

The licensee is proposing to collect data on redd characteristics including location, size, substrate, depth and velocity. When analyzing substrate the Agency recommends that percent embeddedness be included in the characterization. As identified in Vermont’s Wildlife Action Plan (Kart et al. 2005), one of the threats identified is degraded spawning habitat due to sedimentation. Recording percent embeddedness would ascertain if sedimentation is having an impact on survival to emergence. The Brusven Index describes sediment size and percent embeddedness using a three digit number. The number in the 10s place is the largest materials in the sample termed the dominant particle size. The figure in the ones place represents the material surrounding the dominant particles and the decimal place is used to describe the percent embeddedness (fines). These are standard methods for salmonid redd surveys (Gallagher 2007).

The Agency requests that the licensee collaborate with the Agency on the telemetry portion of the study so we can continue to monitor the lamprey once they leave the project affected areas.

The Agency agrees with the licensee's proposed study plan revisions as described below.

A. Rick's comment in describing plan, that this is not in the plan		
	Revise plan to state putting out pressure transducers if we find spawning areas	SP Revised.
B. Clarify that non-telemetered areas (based on physical habitat) and we find redds will be monitored.		
	Revise plan to include what we do when we go to these habitat sites and find redds. Do we then treat them the say way as others? <u>YES.</u> Also other spawning studies we will focus on shallow areas and will look at them. Also clarify the number or "up to how many additional" physically identified redds we will also monitor. See D below	SP Revised.
C. ***Use of habitat data – if half go to tributaries and/or scatter, that doesn't lead you to more than that fish.***		
	May have to find some by plane if needed and they go up tributaries.	SP Revised.
D. Need to identify how many redds you'd measure – specify level of effort to represent adequate sampling and habitat variability. Analysis is subjective so need a lot of redds to get adequate information		
	Clarify in plan - we will count all redds and then subsample.	SP Revised.
E. Tagging should be representative of migration timing – cover the entire season. USGS has been pit-tagging at Holyoke and receivers at TF and Vernon, may provide some info to help inform rates/timing.		
	We won't take the first 20. The goal is to try and select tagged fish throughout the migration period. Clarify and revise plan.	SP Revised. Clarified to spread fish tagged out over different periods
F. What is the scale of the effects analysis? Per redds? Per colony per habitat unit.		
	Will be based on what we find – but will be broad representation of what we find. We	SP Revised.

	will try to do per colony/grouping within each habitat, will report everything found. Will locate and record depth of all. Could also randomly select which ones are capped. Specify scale of effects analysis in the plan.	Plan clarified.
G. Let agencies know if fish move out of the area, so they can be tracked in the states.		
	Will do, add this into plan – will provide/share codes of our tags with states.	SP Revised.
H. [Lael] Refer to Gallagher – standard methods for changes in habitat over period they are actively spawning. Record % embeddedness when evaluating substrate etc. sedimentation within redds (impact on the resource).		
	Specify in plan – once we find redds, additional field work every day in daylight with photos, also will have turbidity data. Also add embeddedness. (see 4th paragraph on p.113 of PSP) in the event of no telemetered fish leading us to that spot, will still look in suitable habitats.	SP Revised. Clarified, but not sure of the Gallagher reference, need a citation in order to review that.
I. Operations data collected at redds? Capture various operational conditions		
	Clarify and add detail on operations data collected and how at redds – may locate pressure transducers; measure velocity and depth at time of observation and link to discharge/elevation at station or other means of estimation of flow. Coordinate with TC Operations to understand what is going on operationally while in daily surveys of redds. Indicate how we will attempt to observe redds under varying flow conditions	SP Revised with clarifications.

Study 17: Upstream Passage of Riverine Fish Species Assessment:

The goals of this study are to determine the use and temporal distribution of riverine fish passing upstream in the existing Wilder, Bellows Falls, and Vernon fish ladders during year-round fishway operation and to determine the appropriate operation period for these fishways to pass riverine and diadromous fish. The Agency requested that monitoring in the fish ladders be conducted year round.

TransCanada is proposing to operate the upstream fish passage year round or until icing condition make or operations are infeasible because of icing conditions. The proposed schedule indicates that TransCanada will set up the video equipment in April 2014. The proposed study plan should be adjusted to state that TransCanada will operate the fish ladder and setup the video equipment and software as soon as conditions allow which could potentially could occur in March.
Additionally, TransCanada is proposing to continuously monitor water temperature within each of the fish ladders during the study. Fish movement and migration is strongly associated with water temperature. Considering this, the Agency recommends that not only continuous temperature is monitor within the fish ladders, but also within the forebay area where fish exit the ladder and tailrace of each project to assess whether the projects operations are potentially impacting important migratory cues. If potential delays in fish migrations are occurring from project operations effect on temperature, the Agency reserves the right to request a more detailed study in the second year on the temperature within the impoundments at any of the projects.

The Agency will work with the licensee and the Salmonsoft company to define terms of use of the software and video monitoring equipment (with the exception of state owned computers).

<table>
<tr><td colspan="3">A. Fish Ladder Operational monitoring:
a. Will you record the number of times etc. that the fishways get blocked? Check often enough to ensure that ladders operate correctly for the study.
b. [J Warner] – maybe get FWS engineers, station staff, study staff together to identify the visual effects of things blocking the fishways.
c. Or periodically shut down to check ladders.</td></tr>
<tr><td></td><td>We don’t want to shut the fishways unless they really get blocked.
Work with station staff to set up an inspection schedule/protocol. Perhaps seasonal shutdown – after spring run and after fall run.
Revise plan as needed</td><td>SP Revised.

Sampling will occur during the open water period (ice-out until freezing temperatures make it infeasible).

TC will develop an in-house protocol for station personnel to assess ladders for blockages on a weekly basis. If a significant blockage is suspected, TC can shut down and address either after the spring or summer periods.</td></tr>
<tr><td colspan="3">B. Use of VT’s Salmonsoft licenses; Receive training and orientation from VT; set-up at Wilder</td></tr>
<tr><td></td><td>Clarify and confirm in Study Plan:
• Confirm use of Salmonsoft licenses held by VT.
• Determine hardware or additional software needs. High processing speeds for software.</td><td>SP Revised.

Added use of VT licenses to SP, added cost to purchase of 3 laptops that can handle the salmon soft software transferred from VT</td></tr>
</table>

<table>
<tr><td></td><td>Develop set –up system for Wilder</td><td>(minimum of a dual core computer running at 2.0 GHz with a suitable video capture device, a minimum of 2 GB of RAM, running Windows XP (preferred) or Windows Vista. The recommended video board is the Plextor PX-AV200U)</td></tr>
<tr><td colspan="3">C. High turbidity events that preclude seeing fish via Salmon Soft - and record those events. Turbidity doesn’t allow Salmon soft to capture the frame if there is movement in the ladder. Sun can trigger Salmonsoft and small light directly into window for nighttime is useful too.</td></tr>
<tr><td></td><td>Specify in plan – 24 hour Salmonsoft usage. Consider the experience from Vernon to ensure the best data collection.

Could use the 2nd camera side-by-side.
FL will share their experience downstream to help study design. VANR can provide protocol.</td><td>SP Revised.

Added text to specify 24 hour coverage. Added text saying we would operate 2nd non salmonsoft camera during turbid periods after rain events.
Added text saying TC can confer with VT and FL to install proven design improvements for limiting sun and night time interference.</td></tr>
<tr><td colspan="3">D. Salmonsoft was designed for upstream. If one fish goes upstream and on that goes downstream at the same time, Salmonsoft can cancel out each other.</td></tr>
<tr><td></td><td>There are work-arounds in the software. Identify methods to address this and enable both up and down counts.

Clarify and specify procedure in revise SP accordingly</td><td>SP Revised.

Added text saying TC would confer with FL and VT to learn about getting net counts from Salmonsoft</td></tr>
<tr><td colspan="3">E. 1-year study may limit identification of early and late season species use (walleyes for example). How early will you open the ladders? If see fish moving early and late, it might be important to define those time frames.
[K Kennedy] – can record temp, flow, elevation etc at the time of first and last seeing fish. Then license conditions could be based on date and/or those conditions</td></tr>
<tr><td></td><td>We expect to be able to get ladders open as soon as reasonably possible and run as late as reasonably possible or when it appears as if no use is observed.

Will need to develop a monitoring protocol in real time rather than wait until season is over to observe and process salmon soft information.

Clarify this and revise the SP</td><td>SP Revised.

Clarified in SP:
Ladders will open as soon as logistically possible (i.e.no ice).

We will record operational parameters.

Monitoring of video files/analysis of data etc. will occur throughout the study, not at the end of the study.</td></tr>
</table>

<table>
<tr><td colspan="3">F. Page 122, schedule says April date.</td></tr>
<tr><td></td><td>Correct this in the SP.
NOTE – will need to coordinate with CRASC and FWS on fishway inspections early at all projects, not just Vernon.

Will periodically check in with agencies on status, especially. if there are issues that arise.

Revise Study Plan</td><td>SP Revised.

SP revised to reflect the open water period (ice-out until freezing temperatures make it infeasible)

Sentence added to indicate TC will coordinate fishway inspections with agencies to ensure timely start to monitoring.</td></tr>
<tr><td colspan="3">G. Will Salmon Soft software run 24 hours continuously?</td></tr>
<tr><td></td><td>Clarify if this is what we are aiming for in SP.

If there is some unforeseen reason why this becomes a problem, we will immediately notify agencies and stakeholders.</td><td>SP Revised.

Clarified 24-hour monitoring. Added a few sentences at end of methods saying TC will be in contact with agencies and if our proposed methodology is not working well, will seek alternate approaches in consultation.</td></tr>
<tr><td colspan="3">H. Consider setting up trial at Wilder in 2013</td></tr>
<tr><td></td><td>We will consider this as an option based on VT work in 2013, but no revision expected in Study Plan</td><td>No change in plan.</td></tr>
<tr><td colspan="3">I. Consider using 2013 recording data for training on species Identification.</td></tr>
<tr><td></td><td>We will consider this and indicate in Study Plan if needed.</td><td>SP Revised.
added</td></tr>
</table>

Study 18: American Eel Upstream Passage Assessment:

The goal of this study is to provide baseline data on the presence of American eels attempting to move upstream of the projects and the locations where they congregate while attempting upstream passage.

During the study plan meetings, it was suggested by FERC that the licensee mark all captured eels to avoid double counting. The licensee has since proposed to pass all captured eels upstream, thereby alleviating agency concerns over recaptures impacting estimates of eel congregations below projects. However, the Agency feels that there is value to marking eels (e.g. elastomer tags) with the goal of obtaining information on movement (e.g. duration between dams, percent passed by dam, number recaptured). The Agency requests that the licensee consider marking eels with elastomer tags to obtain this information.

The Agency agrees with the licensee's proposed study plan revisions as described below, with the addition of marking the eels.

<table>
<tr><td colspan="3">A. Revise Study Plan schedule: monitor with night surveys and eel traps in the first year to identify potential locations for temporary upstream passage devices, install and test those sites in the second year. Include an element of stakeholder consultation prior to passage device deployment.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>SP Revised.
SP edited to reflect a two year approach
Year 1 – systematic surveys – visual searches and eel pots
Year 2 – following consultation with agencies after year 1, temporary eel passes will be installed at appropriate locations where suitable eel concentrations were detected.</td></tr>
<tr><td colspan="3">B. Comment that the minimum number of pots should be 10.</td></tr>
<tr><td></td><td>1. Unclear as to how many we are proposing. Is this per project? Up and downstream? Is this a critical item? Discuss with TC prior to revising SP
2. Clarify number to potentially address this concern.
3. Revise Study plan as necessary</td><td>SP Revised.
We are proposing to fish at least 10 pots per project. Clarified SP to indicate that this is 10 pots at each Project and they are placed in areas DS of the dam</td></tr>
<tr><td colspan="3">C. Study design should account for and document re-captures though some sort of marking of eels prior to releasing them.</td></tr>
<tr><td></td><td>Revise Study plan as necessary</td><td>SP Revised.
Rather than marking yellow eels (some of which have the potential to be very small and difficult to mark), SP has been edited to have eels captured in eel pots during year 1 passed over dam – similar to approach for temporary eel traps during year 2. This will alleviate agency concerns over recaptures impacting estimates of eel congregations below projects</td></tr>
<tr><td colspan="3">D. Study Plan should include consideration for a smaller mesh size associated with traps and specify such.</td></tr>
<tr><td></td><td>Revise Study plan as necessary</td><td>SP Revised.
Reviewed available literature pertinent to mesh retention of eels and agree with agencies. Have modified SP to propose the use of 1/8 " mesh which will greatly increase retention of smaller eels</td></tr>
<tr><td colspan="3"></td></tr>
</table>

Study 19: American Eel Downstream Passage Assessment:

The goals of this study are to identify project-related effects on downstream passage timing, injury, stress, and survival in order to maximize the number of American eels migrating to their spawning grounds.

In the licensee's proposed study plan the objectives of this study are to 1) quantify the movement rates (including timing) and relative proportion of eels passing via various routes at the projects including through the turbines, the Bellows Falls bypassed reach, the current downstream passage facilities, and spillways; and 2) assess instantaneous and latent mortality and injury of eels passed via each route.

These objectives are misleading because they are not assessing mortality through spillway and downstream passage facilities because it is assumed survival is high. Therefore objective 2 should state assess instantaneous and latent mortality and injury of eels passed through each turbine type.

<table>
<tr><td colspan="3">A. In SP, discuss pros and cons of PIT and radio telemetry for this site and this study, provide rational for choosing not to include PIT.</td></tr>
<tr><td></td><td>Revise Study Plan to explain the rationale and experience for choosing radio telemetry and not PIT technology.</td><td>SP Revised
Rationale described.</td></tr>
<tr><td colspan="3">B. Consider survival studies through spill gates in the scope of the study.</td></tr>
<tr><td></td><td>1. What are the gate passage options for eels specific to projects including gate operation priority and flow in terms of how they operate – bottom or surface; minimum flow or gate opening etc.
2. Is there literature on adult eel gate passage survival?
3. Consider an assessment methodology that would reach a consensus as to whether or not additional survival studies would be necessary in a second study season.</td><td>SP clarified as follows:

TC expects gate passage survival to be high in general.

As part of the route selection study, we will consult with TC Operations on gate structures operations to evaluate potential gate-specific issues. We are not aware of literature on gate passage, but can review as part of the study.

We could consider gate survival evaluation if the route selection portion of the study indicates that a significant proportion of fish use the spillways and if sufficient numbers of fish are available (see C below). We will consult with the aquatics working group on the need for potential changes to the scope of the survival portion of the study and/or an alternate desktop methodology to assess this.</td></tr>
</table>

C. Sample size per turbine types appears low – consider boosting sample size per unit type		
	1. Evaluate the additional scope and cost. 2. Revise Study Plan as necessary and provide rationale.	SP clarified as follows: The survival sample size in the study plan is the same as requested by the resource agencies (including survival through all passage routes). It appears that agencies realize that a large number of eels would likely not be available, so they specified 50 for each project. By limiting survival to just turbines and not gates, the number of fish per turbine type is increased. We also believe that the number of tags and effort required to capture higher numbers of fish (if available) for survival studies would be cost-prohibitive. We propose to use the preliminary route selection data to focus allocations of fish for turbine survival (and gate survival if appropriate - see B above). For example if 60% of the fish in the route selection study use turbines 1-4 (a single turbine type) at Vernon then 60% of the allocated 50 eels for that site would be tested through one of those turbines
D. To what extent will the study incorporate the results of the radio-tag (RT) monitoring results (route selection, movement activity, preferences, or lack thereof) and the survival analysis portion of this study? Will or should the RT results determine the scope or distribution of survival study distribution?		
	Revise Study Plan as necessary and provide clarity on the process or linkage.	SP Revised. Plan clarified – see also B and C above.
E. Study plan should reflect radio tagging releases to coincide with the mid-September thru early October period.		
	Revise Study plan as necessary.	SP Revised. Field study will be conducted late August through mid-October.
G. [from Study 11 discussion] Comment on tagging, loosely associated with Study 19 (Downstream eel passage). Is TC tagging yellow eels, or willing to? TC monitor in impoundments and VT would take over when eels entered VT tributaries.		
	Will we be monitoring movement in project waters using fixed and mobile tracking? Revise plan to clarify above and that we can provide tag information to agencies.	SP revised for clarity. This study and requests were for silver eels only. We are not proposing to tag yellow eels. Manual monitoring is already

		included in the plan along with fixed stations. SP revised to share tag information with agencies in addition to sharing with FL.

Study 20: American Eel Downstream Migration Timing Assessment:

As stated in the licensee's study plan, the goal of the requested study was to assess the timing of American eels migrating from the Connecticut River to their spawning grounds. The specific objective is to characterize the general migratory timing and presence of silver phase American eels in the Connecticut River compared to environmental factors including air and water temperature, turbidity, rainfall, river flow, lunar phase and flow-related operations of mainstem river hydroelectric projects. The licensee states in its study plan (pg. 189), "However, it finds that a field study is premature at this time. There are few American eel upstream of the TransCanada projects, as indicated by annual electrofishing conducted in the lower portion of Vernon impoundment as summarized in the Vernon PAD, and collections made by Yoder et al. (2009) above the Bellows Falls and Wilder dams."

Considering there have been no targeted eel surveys in riverine and lacustrine habitat on the Lower Connecticut River as well as in the ponds and tributaries of the Connecticut River basin, it is unknown how many eels are residing within and/or outside of project bounds. As such the Agency requests that this statement be revised as follows,

"There have been few documented American eel upstream of the TransCanada projects in the mainstem Connecticut River, as indicated by annual electrofishing conducted in the lower portion of Vernon impoundment and as summarized in the Vernon PAD, and collections made by Yoder et al. (2009) above the Bellows Falls and Wilder dams".

Similarly, the project nexus states (pg. 192), "Currently the TransCanada projects have little, if any, direct effect on the overall outmigration of Connecticut River American eel because so few eels exist upstream of the TransCanada projects"

The Agency requests that this statement be removed because it is unknown how many eels exist upstream of the TransCanada projects. This statement also suggests that if eel numbers are already low, then TransCanada could have more of an impact on their population.
As stated above, sampling efforts will likely underestimate the distribution and abundance of the eels because the scope is limited to the mainstem of the Connecticut River. This should be accounted for in the analysis.

The Agency does not agree with section B as described below.

A. Include potential American eel observations noted during Study 17 in the information and assessments presented within Study 20		
	Revise Study Plan to reflect that observations	SP Revised.

	and timing from Study # 17 will be documented in Study 20	Included study 18 – upstream eel passage, study 17 – resident species upstream passage (may have incidental eels) and study 11 – eel survey.
B. Consider extending scope of the study into the tributaries of the CT River.		
	TC does not intend to expand the geographic scope of this study to include an assessment of American eel in tributary waters. TC considers this expansion to be a request to perform species management analyses rather than a study to determine the effect of project operations on American eel migration timing.	No change in the plan.
C. Revise the study plan objectives and goals when stating that because so few eels were captured above the dam state "in the mainstem" because there may be many eels in tributaries and lakes.		
Clarify this in the study plan		SP Revised.

Study 21: American Shad Telemetry Study – Vernon:

The goals of this study are to 1) characterize the potential effects from project operations on behavior, approach routes, passage success, survival, and residency time by adult American shad as they encounter the Vernon Project during both upstream and downstream migrations; and 2) characterize whether if project operations affect American shad spawning site use and availability, spawning habitat quantity and quality, and spawning activity in the river reaches downstream and upstream of Vernon dam and in the area downstream of the Bellows Falls Project.

In the licensee's revised study plan in the Method Section (pg. 201) states, "Tagged shad will be manually tracked and spawning areas located." It does not state as to what frequency tracking in the area between Vernon and Bellows Falls will occur. The Agency recommends that the methods and frequency of tracking be consistent with previous study approaches used by Conte Laboratory which will be beneficial in the additional review of study data from 2011 and 2012, as noted.

The Agency requests that tagged individuals be selected from the early, middle and late part of the run to fully represent the breadth of the run. Incorporating mortality add-ons would provide more conclusive results related to the project's impacts on survival.

As noted, it is expected that FirstLight and TransCanada will coordinate so radio tag study fish, will share radio tag frequencies, code sets, and codes. The Agency requests that fish be tagged below Turners Falls and be allowed to proceed upstream as they would naturally. This will give the Agency a better idea of the condition that these fish are in and experience as they migrate upstream through the projects.

In order to determine if Bellows Falls operations are affecting American shad spawning site use and availability, spawning habitat quantity and quality, and spawning activity downstream of the Bellows Falls Project the Agency requests that stationary receivers be deployed between the lower Vernon impoundment and Bellows Falls Project.

The Agency is in agreement with the changes to the revised study plan as described below.

<table>
<tr><td colspan="3">A. In SP identify what the goal and differences this study contains versus the Study in 2012 conducted by USGS with TC support. Identify why we believe the 2012 data that has not yet been processed, used with the results of this study may provide a good picture of Shad movement up to Vernon and through Vernon and in particular the near-field behavior monitored in this study.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>SP Revised.</td></tr>
<tr><td colspan="3">B. What is the number of tagged shad necessary to reduce signal collisions? Is there a maximum? By releases groups or by total? Consider with respect to early, mid, and late season spawners.</td></tr>
<tr><td></td><td>Examine options for accommodating this. Revise Study Plan if necessary</td><td>SP revised as proposed here:

We feel that 60 tags may provide a better balance between numbers and signal collisions. The draft SP was for 40 tags, agencies had suggested 100.

SP revised for timing (see E below).</td></tr>
<tr><td colspan="3">C. Conservatively, TC should not count on radio tagged shad from Vernon (from Bob Stira of FL).</td></tr>
<tr><td></td><td>Not a critical element in TC’s study, but duly noted.</td><td>No change in plan.</td></tr>
<tr><td colspan="3">D. Better describe and illustrate the telemetry layout:, receivers locations, tracking coverage areas, fish ladder wiring and monitoring locations – both up and downstream. Identify all fixed receiver sights below Vernon, at Vernon and upstream of Vernon.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>SP Revised.

Figures added to plan and clarified in the SP.</td></tr>
<tr><td colspan="3">E. Study should be designed to reflect the entire shad run. Collecting and releasing shad from the early, middle and late run. Timing and breadth of the run should be captured.

Potential data points to assess these periods include: historical returns - data and trends; real-time monitoring or actual counts at Holyoke; real-time temperature monitoring (First Light? and TC or Holyoke); good and active communication between TC and fishery agencies.</td></tr>
<tr><td></td><td>Will consider and revise Study Plan as needed.</td><td>SP revised as proposed here:

Unless 2012 data (when analyzed)</td></tr>
</table>

<table>
<tr><td></td><td></td><td>indicates otherwise, we expect to tag 1/3, 1/3 and 1/3 in early, mid and late season, respectively.

Consultation/communication with agencies is already part of the SP.</td></tr>
<tr><td colspan="3">F. Consider Mortality Tags vs. what we are proposing.</td></tr>
<tr><td></td><td>Will consider and revise Study Plan as needed.</td><td>If in agreement SP will be revised..</td></tr>
<tr><td colspan="3">G. Provide better clarity, process, consultation and decision making associated with reviewing 2012 and possibly 2011 USGS study data to determine ultimately the final # of tags, monitoring locations, source of fish and release points.</td></tr>
<tr><td></td><td>1. Better delineate the steps and time table
2. Propose criteria for decision making – this might be modified in the final SP following additional consultation (could add a comment in the revision to that effect)
3. Revise Study Plan</td><td>SP Revised.

Expanded section on 2012 data review, including consultation after 2012 data is analyzed.</td></tr>
<tr><td colspan="3">H. Include elements to better assess the impact on shad migration potentially caused by the Bellows Falls operation – both movement and spawning. Consider multiple fixed receiver locations below Bellows Falls.</td></tr>
<tr><td></td><td>Will consider and revise Study Plan as needed.</td><td>SP Revised.

Added one monitor in Bellows Falls bypassed reach and one monitor in the Bellows Falls tailwaters - see Figure 21-2.</td></tr>
<tr><td colspan="3">I. Numbers of radio tagged fish released as “late season” representatives may need to be greater than numbers of the previous early and middle representative fish due to inherent late season mortality or fatigue in order to capture a reasonable sample population size to observe.</td></tr>
<tr><td></td><td>Will consider and revise Study Plan as needed.</td><td>SP revised as proposed here (same as E above):

Unless 2012 data (when analyzed) indicates otherwise, we expect to tag 1/3, 1/3 and 1/3 in early, mid and late season, respectively.
The increased number of fish proposed (in B above) should alleviate this concern.</td></tr>
<tr><td colspan="3">J.
a. If we use Holyoke fish and release them or some of them above TF would we be able to detect their potential downstream movement at TF?

b. Describe in the SP how we could coordinate and share tag specifications: tag codes, pulse</td></tr>
</table>

<table>
<tr><td colspan="3">rates, frequencies, receivers with FL to reduce signal collision and expand tracking network and numbers of overall tagged fish for both studies.

c. Is there any value in releasing a portion of the fish into the canal or below TF as well as above TF?</td></tr>
<tr><td></td><td>Will consider and revise Study Plan as needed.</td><td>No changes in SP at this time.

a. TC and FirstLight would each be able to detect those fish within their respective studies.
b. Sharing of info/tracking is included in the SP. However, it is too early for detailed discussions with FL on how that will happen, but both companies have agreed in principle to share information.
c. For purposes of TC's study there is no value in this request, this should be requested of FL for their studies.</td></tr>
<tr><td colspan="3">K. Consider adding language in the SP with respect to criteria or reasons that would warrant repeating all or portions of Study #21 in a second season.</td></tr>
<tr><td></td><td>Will consider and revise Study Plan as needed.</td><td>No changes in SP at this time.

We feel that a single study year is sufficient. An additional study year would be subject to FERC's review of the year 1 study results.</td></tr>
</table>

Study 22: Downstream Migration of Juvenile American Shad – Vernon:

The study goal is to determine whether project operations affect juvenile American shad outmigration, survival, production, and recruitment. The specific objectives of this study are to 1) assess project operation effects on the timing, route selection, migration rates, and survival of juvenile shad migrating past the project; 2) characterize the proportion of juvenile shad using all possible passage routes at Vernon over the period of downstream migration under normal operational conditions; and 3) conduct controlled turbine passage survival tests for juvenile shad passed through one of the older Francis units (Unit Nos. 1 - 4) and one of the new Kaplan units (Unit Nos. 5 - 8) to estimate the relative survival specific to those unit types.

In order to gain a better understanding of fish movement patterns with respect to seasonality, flow conditions, and temperature conditions, the Agency requests that hydroacoustic assessment technology be employed. The use of hydroacoustics in the forebay will provide a more accurate picture of the timing, duration, and magnitude of juvenile shad migration through the Vernon project as well as assess the timing and duration of other migrator species such as American eels.

Study 23: Fish Impingement, Entrainment, and Survival Study:

The goal of this study is to assess the adequacy of the intakes at the projects to minimize fish mortality resulting from impingement and entrainment of fishes residing in the Connecticut River. The objectives of the study will be accomplished through desktop analysis, not through field study as requested by other entities. As stated in the project nexus, this study will provide data to establish a baseline condition to assist in evaluating entrainment and impingement potential and the expected survival of those fish at each of the projects. However, the Agency feels that a desktop analysis alone would not provide the information needed to calculate the above. The Agency requests that in addition to the desktop analysis, estimates be ground-truthed by obtaining a sub-set of the actual numbers impinged or entrained. This would insure the study results would be more conclusive.

Study 24: Dwarf Wedgemussel and Co-occurring Mussel Study

The proposed study plan largely meets the Agency's requirements and we have no further comments. The Agency will work with the licensee as proposed in the revised study plan after the Phase 1 portion of the study is completed to further develop the study design.

Study 25: Dragonfly and Damselfly Inventory and Assessment

The Agency requested a study on the effects of water level fluctuations from project operations on odonate species of greatest conservation need. The licensee's proposed study plan does not indicate at what water level the field surveys will be conducted. The Agency request that field surveys be standardized to the extent possible as the level of the impoundment or generation flows could greatly affect the survey. The Agency recommends that the impoundment elevation or project flows be recorded at the beginning and end of the each survey. Additionally the study plan should be clarified to indicate that height or elevation of each alarvae, tenerals, and exuviae found will correspond to the impoundment operation elevations.

Study 26: Cobblestone and Puritan Tiger Beetle Survey

The licensee has incorporated many of the Agency's comments into the proposed study plan and it largely meets the Agency's requirements and we have no further comments.

Study 27: Floodplain, Wetland, Riparian, and Littoral Habitats Study

The proposed study plan largely meets the Agency's requirements and we have no further comments.

Study 28: Fowler's Toad Study

The Agency study request for the Fowler's toad survey recommended that the study include wet road searches and wildlife acoustic recorder to increase the likelihood of detecting toads. TransCanada study proposal does not include the use of wet road searches and only will use wildlife acoustic recorders depending on the habitat available. The Agency request that TransCanada use wet road surveys because it allows you to find Fowler's Toads outside of their brief breeding period and away from the breeding pools. This will greatly expand your time-search window and allows you to find toads in their terrestrial habitat away from breeding pools and may provide useful information that would lead to the discovery of alternative or unexpected breeding and foraging habitat within the project boundary. Small roads within the floodplain and within a mile of the river could be targeted.

Additionally, the Agency continues to recommend that TransCanada use wildlife acoustic recorders. Using acoustic wildlife recorders would allow for continual gathering of call data from a handful of the most promising locales without requiring the presence of observers, increasing the likelihood of detection of breeding sites during the brief breeding period. Furthermore, predicting when weather conditions will be right for breeding is difficult, therefore relying on the three call surveys conducted in late May through July will not be adequate and using the acoustic wildlife recorders would increase the likelihood of detection.

Study 29: Northeastern Bulrush Survey

The licensee has incorporated many of the Agency's comments into the proposed study plan largely meets the Agency's requirements and we have no further comments.

Study 30: Recreation Facility Inventory, Use and Needs Assessment

The goal of the Agency's study request for recreational survey and enhancement is to identify opportunities for improving recreational opportunities at project facilities and on project lands, including new or improved recreational facilities and changes in project operations. TransCanada's proposed study plan includes an inventory at recreational facilities currently available to users to evaluate the site conditions and ability to meet the recreational demand, and to identify any impediments to recreational users. Additionally, TransCanada is purposing to conduct recreational user surveys and site inventory evaluations between May 1 and September 30 with survey of users ending around October 15. The Agency concern is that by ending the study at the end of September the study will not include any comments from the winter recreationalist that ice fish, cross country skiing, snowshoe, or snowmobile. Furthermore, the site evaluation form should indicate if the recreational facility is maintained on a regular basis in the winter months, as a major impediment to winter recreationalist could be lack of access to unplowed facilities.

The Agency has the following comments on the attached forms that were submitted with the proposed study plan.

- Attachment 30-D: On-Site Intercept Survey - Question 17: The Agency request that TransCanada include winter activities such as ice fishing, snowmobiling, cross country skiing, and snowshoeing in the list of activities.

- Attachment 30-D: On-Site Intercept Survey – Question 24: The Agency request that TransCanada modify or include an additional question that ask the recreationalist if their recreational experience had ever been effected by fluctuation in water levels at either the Wilder, Bellows Falls, or Vernon reservoirs or downstream of the projects.

- Attachment 30-E: Potential Visitor Questionnaire: Section 1 Mail/Internet Survey – Question 6: This question request that a recreationalist select only the primary season (Winter, Spring, Summer, and Fall) which the person recreates on the Wilder, Bellows Falls, or Vernon reservoir or downstream of the projects. This question should be reworded so that a recreationalist can select any season that they recreate in the vicinity of the projects. The Agency's concern is that multi-seasonal recreationalist will not be captured in the survey.

- Attachment 30-E: Potential Visitor Questionnaire: Section 2 Mail/Internet Survey – Question 24: The Agency request that TransCanada include winter activities such as ice fishing, snowmobiling, cross country skiing, and snowshoeing in the list of activities.

Study 31: Whitewater Boating Flow Assessment – Bellows and Sumner Falls

No comments.

Study 32: Bellows Falls Aesthetics Flow Study

The licensee has incorporated many of the Agency's comments into the revised study plan, and it largely meets the Agency's requirements and we have no further comments. The licensee should incorporate the Agency's input as it refines and selects the observation point for the study.

Comments on Study Request Not Accepted:

Climate Change Study

The Agency requested a study on climate change. TransCanada did not develop a study plan for this request. It is already clear that climate change is affecting weather patterns in Vermont and elsewhere as identified by Betts (2011). One of the effects is an increased frequency and magnitude of extreme weather, such as dry spells or heavy rain events. This is resulting in a change in the hydrology of our rivers and streams. We should expect to see more severe low flow events, possibly with increased frequency and duration. The same thing should be expected concerning high flows. Overall, conditions will also be more erratic.

Since the Vernon, Bellows Falls and Wilder hydropower projects regulate the flow of the Connecticut River, their future operation will not be the same as it has been in the past. Even if precipitation increases, their ability to generate may decrease, both as a result of more low flow conditions and as a result of more high flow conditions when the projects must drop the headpond elevations to manage flood conditions.

Both situations also affect the ability of the projects to provide environmental flows and to meet objectives for relatively stable impoundment levels. Furthermore, the US Department of Energy report on *Effects of Climate Change on Energy Production and Use in the United States* (2008) identified these as potential impacts from hydroelectric projects as well as issues with temperature-related stresses, operational modification from extreme weather (floods/droughts), and the alteration of habitat for threatened and endangered species.

Operational modeling (Study 5) will be used to assess operating alternatives. However, this modeling is built on historic river gage records and historic operation of the projects, neither of which reflects future conditions. Modeling should include scenarios that are likely to be experienced during the upcoming license period.

A climate change prediction model should be used in conjunction with other information about Connecticut River hydrology to predict the future river flow regime. This regime can then be used in conjunction with the operations model to assess new operating regimes that include environmental measures.

References:

Betts, A.K. 2011. Vermont Climate Change Indicators. Weather, Climate, and Society 3: 106-115.

CCSP, 2007: *Effects of Climate Change on Energy Production and Use in the United States*. A Report by the U.S. Climate Change Science Program and the subcommittee on Global Change Research. [Thomas J. Wilbanks, Vatsal Bhatt, Daniel E. Bilello, Stanley R. Bull, James Ekmann, William C. Horak, Y. Joe Huang, Mark D. Levine, Michael J. Sale, David K. Schmalzer, and Michael J. Scott (eds.)]. Department of Energy, Office of Biological & Environmental Research, Washington, DC., USA, 160 pp.

Attachment B
VANR Comments on FirstLight Proposed Study Plan

3.3.4 Evaluate Upstream Passage of American Eel at the Turners Falls Project

The goal of this study is to identify and assess potential locations for upstream American eel passage at the Turners Falls Project.

According to the Updated Proposed Study Plan dated June 28, 2013 systematic surveys of eel presence and relative abundance will be conducted 10-12 times during the 2014 eel upstream migratory season. The first survey will be initiated within one week of eels being observed downstream of the project area at the Holyoke eel pass, with subsequent surveys occurring at night after precipitation events throughout the 2014 migration season. The study plan should clarify an end date for the surveys.

According to Murphy and Willis (1996) systematic surveys are conducted by selecting sampling units and or events at regular intervals. For example, TransCanada is proposing to conduct visual surveys at night, once per week, downstream of each dam on foot (wading) or from a boat from May 1 through October 15 (or when water temperature exceeds 50^{o}F). This sampling regime more closely reflects the definition of systematic and should be considered. Please clarify how this study meets the definition of systematic, as surveying after precipitation events is more impromptu rather than systematic.

Recorded data will include location, observation of eels (presence, absence) and relative numbers, relative sizes, behaviors, and time/date of observation, recent weather, and current discharge. Please clarify what it is meant by relative, as the term estimated might be more appropriate.

In addition to visual surveys the Agency requests that eel pot trapping be conducted to gain a better understanding of eel numbers and sizes. Data collected should include location, number captured (or recorded as none captured), estimated sizes, and time and date of observation. Each eel should be assigned a length class (0 to 6 inches, 6 to 12 inches, 12 to 18 inches, and >18 inches). The first 10 individuals within each length class should be individually measured for total length (nearest mm) and wet weight (nearest gram). The first 10 individual eels in the >18-inch length class should also have eye diameter measurements recorded. To facilitate collection of length and weight data as well as prevent unnecessary injuries to the eels, it may be necessary to anesthetize individuals using an appropriate anesthetic for the species (i.e., ice, clove oil, or MS-222).

Murphy, B. R., and D. W. Willis, editors. 1996. Fisheries techniques, second edition. American Fisheries Society, Bethesda, Maryland. 732 pages.

3.3.6 Impact of Project Operations on Shad Spawning, Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Projects

In order to determine the impacts that project operations have on shad spawning the Agency requests that shad eggs be sampled in randomly selected areas after observed spawning events. As stated in the updated study plan ichthyoplankton nets will be deployed downstream of suspected spawning areas that may potentially become dewatered. However, dewatering is only one factor that could potentially affect spawning success (e.g. sedimentation could also impact spawning success). Therefore, the Agency requests that eggs also be randomly collected to quantify viability, and to represent a range of conditions that could potentially hinder success. Density of eggs collected per sample should be determined by enumerating a sub-sample and relating that to volume of water filtered. Spawning activity and fervor should be described subjectively and relatively to other spawning activities observed. Factors affecting egg collection, i.e. water turbulence, high velocities, shallow depth, should be noted. In order to gauge the effects of project operations on shad spawning, collected data should be analyzed and compared to project operational data. The times and dates of all observed spawning activities, substrate description, water measurements (i.e., velocity, temperature, dissolved oxygen, pH, conductivity, and turbidity), and observational characteristics or anomalies (e.g., extensive water roiling or turbulence) should be recorded and related to the operational data.

Observed effects of the projects should be classified per operational regime observations: 1. no effect –no observable effect on spawning, viable eggs were collected; 2. moderate effect – observable possible effect on normal spawning activity; spawning may have been hindered but viable eggs were collected; and 3. adverse effect – project operations likely to have prevented successful spawning of shad; no viable eggs collected.

3.3.7 Fish Entrainment and Turbine Passage Mortality Study

The goal of this study is to assess fish impingement, turbine entrainment, and turbine passage survival at the two Projects. The requestors proposed that a field study be conducted to assess fish entrainment from the Connecticut River at the Northfield Mountain Project. In addition to the desktop analysis as described in the proposed study plan, the Agency requests that estimates be ground-truthed by obtaining a sub-set of the actual numbers impinged or entrained. Results would then be more conclusive.

3.3.11 Fish Assemblage Assessment

The goal of this study is to provide baseline information pertaining to the fish assemblage structure within the study area. Specific objectives include to:

- Document species occurrence, distribution, and relative abundance of resident and diadromous fish within the project area along spatial and temporal gradients.

- Describe the distribution of resident and diadromous fish species within reaches of the river and in relationship to habitat.

- Compare historical records of fish species occurrence in the project area to results of this study.

Methodology:

The study area will be divided into stations based on habitat type; multiple methods of fish capture will be used in each station. Please describe the habitat types, the spatial extent of each station, whether or not stations will be continuous or non-continuous within the study area, how many samples will be collected with each gear type, how the sample locations will be selected in each station, and whether or not all gear types will be used in each station.

Task 1: Sampling Location Selection

The licensee states that prior to field sampling, stations to be sampled will be selected to ensure all habitat types are adequately represented. Alternative sampling locations will also be identified by habitat in case a selected sampling station is inaccessible.

However, on page 3-178 the licensee states that the proposed study will include a statistically rigorous and comprehensive stratified-random design similar to what has been used successfully on large rivers a high degree of spatial heterogeneity. Please clarify how the study design will accomplish this. Employing a stratified-random sample design ultimately removes bias from the collected data, allows for clear interpretation of results, and provides the best information for making decisions. To capture the spatio-temporal variability, sites/samples should be stratified by habitat type, depth of water, day or night (or time of day), as well as distance from the dam, and season (spring, summer fall).

The study area will be divided into stations based on habitat type; multiple methods of fish capture will be used in each station. Selected locations within each station will be sampled during the early summer and again in the fall. At least 18 stations will be sampled during each sampling event. Early summer sampling will be performed when spawning anadromous species are present; fall sampling will be performed when most juvenile fish are large enough to sample. The Agency requests that sampling be conducted spring (April-June), summer (July-August), and fall (September-October), in order to capture the temporal variability (i.e. fishes occupy different habitats during different seasons).

Proposed methods include boat electrofishing (shoreline and littoral habitat), gill nets (deeper, benthic areas), and seine net (wadeable shoreline and littoral habitat). The licensee should also consider employing a benthic trawl in order to actively (vs. passively) target deep water benthic habitat.

Fish assemblage studies typically employ a multi-gear approach as referenced in Bonar, S. A., W. A. Hubert, and D. W. Willis, editors. 2009. Standard methods for sampling North American freshwater fishes. American Fisheries Society, Bethesda, Maryland. 335 pages.

The Agency recommends that sampling methodologies are consistent with the American Fisheries Society national standards as referenced above.

Task 2: Fish Capture

Please specify if electrofishing will occur during the day or night. The Agency recommends a combination of both in order to capture fishes that move inshore during the night (e.g. bass).

The licensee is proposing that gill nets will be set in selected locations and allowed to fish for 24 hours prior to retrieval. Due to high mortality associated with a 24-hour soak time, the Agency recommends that sets be limited to two hour duration.

3.3.13 Impacts of the Turners Falls Project and Northfield Mountain Project on Littoral Zone Fish Habitat and Spawning Habitat

The goal of this study is to collect information in order to determine if project operations negatively impact fish species so that appropriate mitigation measures may be developed, if warranted, to protect and conserve the species utilizing project waters. Specific objective of this study are to 1) assess timing and location of fish spawning in the littoral zone, 2) delineate, qualitatively describe (*e.g.* substrate composition, vegetation type and relative abundance), and map shallow water habitat types subject to inundation and exposure due to project operations, evaluate potential impacts of impoundment fluctuation on nest abandonment, spawning fish displacement and egg dewatering. However, it is well known that the widened impoundments due to the dams replace riverine (lotic) habitats with a lake-like (lentic) environment. These impoundments serve as repositories for silt and sediments that cover natural gravel substrate that serve as spawning and habitats. Therefore, the Agency is requesting that the study investigate sedimentation, or the amount of fines within a nest (in addition to nest abandonment, spawning fish displacement, and egg dewatering) as a potential negative impact due to the project's impoundments.

In addition to visual surveys, the Agency requests that the licensee deploy egg traps in order to assist in the identification of spawning sites for species such as walleye and white sucker; two riverine fish species which broadcast spawn their eggs. Egg traps should be constructed of standard 8x16 inch concrete blocks wrapped in hog's hair synthetic filter media that forms an ideal surface to collect the broadcasted white sucker and walleye eggs. Egg traps should also be set in some of the lower tributaries with the proper habitat that are influenced by project operations to attempt to locate their spawning sites.

The Agency requests that data on the depth of the nesting site, fish species, water quality data (temperature, DO, pH, conductivity, and turbidity) and habitat type (i.e., aquatic weed bed, gravel bar) be recorded. Water level recorders should also be employed to facilitate determining the effects of project operations on spawning of target resident fish species.

3.3.14 Aquatic Habitat Mapping of Turners Falls Impoundment

Due to the higher turbidity in the lower river, the Agency requests that habitat data be collected using a side scan sonar system, and then validated via ponar dredge or through use of a sediment probe to generally classify substrates.

In order to quantify the composition of substrates collected from the ponar grab, the Agency recommends that samples be brought back to the lab for further analysis. Percent composition by weight using the modified Wentworth scale would provide additional information on the aquatic benthic habitat, and would not require much more effort.

3.3.15 Assessment of Adult Sea Lamprey Spawning within the Turners Falls Project and Northfield Mountain Project Area

The goal of this study is to determine the impacts that operations of the Turners Falls Project and Northfield Mountain Project may have on sea lamprey spawning activity. One of the objectives of the study is to collect the information to assess whether operations of the Turners Falls Project and Northfield Mountain Project are adversely affecting spawning areas (*i.e.*, if flow alterations are causing dewatering and scouring of lamprey spawning area).

As identified in Vermont's Wildlife Action Plan (Kart et al. 2005), one of the threats identified is degraded spawning habitat due to sedimentation. Recording percent embeddedness would ascertain if sedimentation is having an impact on survival to emergence and should be included in the analysis. The Brusven Index describes sediment size and percent embeddedness using a three digit number. The number in the 10s place is the largest materials in the sample termed the dominant particle size. The figure in the ones place represents the material surrounding the dominant particles and the decimal place is used to describe the percent embeddedness (fines). These are standard methods for salmonid redd surveys (Gallagher 2007).

See Gallagher, S.P, P.K. Hahn, and D.H. Johnson. 2007. Redd Counts. Pages 197–234 in D.H. Johnson, B.M. Shrier, J.S. O'Neal, J.A. Knutzen, X.Augerot, T.A. O'Neil, and T.N. Pearsons. Salmonid field protocols handbook: techniques for assessing status and trends in salmon and trout populations. American Fisheries Society, Bethesda, Maryland.

In order to identify specific lamprey spawning sites within the study area, and observe spawning activity of lamprey, the Agency requests that a minimum of 30 lamprey be radio tagged and tracked to spawning locations. All redds should be enumerated and a sub-sample of redds(to include as much habitat variability as possible) should be chosen to monitor daily. Environmental variables including water velocity, depth, temperature, exposure, and relative condition of redds/area will be measured; and the grounds photographed if possible, over the range of normal project discharges in order to characterize operational effects.

The Agency requests that success of spawning by sea lamprey within the project-affected areas be characterized by emergence of larvae from capped redds, if larvae emerge, spawning was successful. If eggs do not hatch, and no larvae emerge, spawning was not successful. Emerging

larvae should be enumerated and timing of emergence relative to redd construction will be documented. Redds should be characterized as to location, range and average depth, general surrounding substrate, and range and average water velocity.
Effects of the projects will be classified per operational regime observed as:
1) No effect - no observable difference to habitat/redd structure or lamprey activity – successful spawning documented.
2) Moderate effect – observable difference to habitat/redd structure and/or behavior noticeable but not enough 3) Large effect – observable structural differences to habitat/redds and observable decreased spawning activity – minimal to no successful spawning documented.
4) Severe effect – noticeable habitat/redd degradation, i.e. de-watered, scoured out, and conditions, depth, water velocity, preclude normal spawning activity – no successful spawning documented.

3.3.17 Assess the Impacts of Project Operations of the Turners Falls Project and Northfield Mountain Project on Tributary and Backwater Area Access and Habitat

The goals of this study are to determine if water level fluctuations from the Turners Falls and Northfield Mountain Projects result in reductions of available aquatic habitat due to movement barriers and/or habitat alterations.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))
The licensee states that common tools to evaluate water level impacts may be used including: bathymetric mapping; habitat measurements (*e.g.,* substrate, depth and velocity), and water quality information (*e.g.,* dissolved oxygen, temperature, turbidity, and pH). Other methods (river bed surveys, visual inspections, GIS/GPS mapping, and hydraulic/habitat modeling) will also be utilized.

The Agency requests that water level recorders (pressure transducers) be employed to determine if water level fluctuations from project operations cause impediments to fish movement into and out of tributaries within the project-affected areas. If the water level drops to 1 foot or less water depth during low impoundment water levels, it should be assumed that movement is impeded. Water level recorders should be placed in tributary areas and operate for an entire year to collect hourly depth changes and water temperature. Additional water quality data should be collected in these areas (temperature, DO, pH, conductivity, and turbidity) if it is found that access to the main river is impeded.

Utilizing pressure transducers in addition to the methods described would provide more conclusive results.

VERMONT

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Agency of Commerce and Community Development

July 15, 2013

Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, D.C. 20426

Re: VT SHPO Comments on the July 8, 2013 Updated Proposed Study Plan for the Wilder (FERC No. 1892-026), Bellows Falls (FERC No. 1855-045), and Vernon (FERC No. 1904-073) Hydroelectric Projects, TransCanada Hydro Northeast, Inc.

Dear Secretary Bose:

Thank you for the opportunity to comment on the above referenced project.

The Vermont Division for Historic Preservation (Division) is providing the Federal Energy Regulatory Commission (FERC) with the following comments pursuant to 36 CFR 800.4, regulations established by the Advisory Council on Historic Preservation to implement Section 106 of the National Historic Preservation Act. Project review consists of assisting FERC in identifying the project's potential impacts to historic buildings, structures, historic districts, historic landscapes and settings, and known or potential archeological resources that are listed in or may be eligible for inclusion in the National Register of Historic Places (National Register).

The Division is pleased to note that the July 8, 2103 version of the Study Plan 33, the Cultural and Historic Resources Study, contained the majority of the revisions discussed and suggested at the June 7, 2013 study plan meeting and during the July 2, 2013 phone conference call. Specifically, the addition of Phase IB site identification and Phase II site evaluation components to the study plan clearly go a long way toward alleviating the gaps in the Section 106 site identification and evaluation process present in the Preliminary Application Documents (PADS) and original Study Plan 33. However, the Division also notes that TransCanada has still included language in the updated study plan that limits implementation of the Phase IB and Phase II studies pending final definition of the Project APEs by FERC in consultation with the SHPOs and Native American tribes.

From our standpoint, the Division believes that an APE determination to include 10 meters (33 feet) of land inland from the top of bank is the minimum acceptable APE limit. The Division accepts that the primary focus of any studies should be within areas of the APE that are actively eroding, but an APE limit of 10 meters around all Project margins for the purposes of historic property inventory and evaluation is appropriate. In fact, the recommended APEs in the updated study plan include this distance in association with actively eroding areas but some statements, such as the second paragraph on page 11 of the Study Plan, seem to imply that the APE definition to include the 10 meter extension is provisional on the results of hydraulic, operations, and erosion studies. As discussed at length in our March 1, 2013 comment letter on the PADS, and in the study plan meeting and conference call, the Division believes there is sufficient information at present to conclude that the Projects effects on bank destabilization, whether specifically determined to be direct or indirect, warrant Phase IB site identification and Phase II site evaluation studies on land adjacent to the impoundments and that such lands are contained within the APE.

Aside from clarification of the APE boundary, the Division generally supports the procedures and methodologies presented in the updated Study Plan for evaluating the Projects effect on both archaeological and structural historic properties. This includes the review of the draft Phase IA reports for the Wilder and Bellows Falls projects and the update to the Vernon Project Phase IA report following the completion of 2013 monitoring program. In the latter case, it does appear that any modification to the APE in Vernon based on identification of erosion or other threats to sensitive areas or sites as outlined on page 12 of the Study Plan conflicts with the statement on page 10 that TransCanada that the APE for the Vernon Phase IA adequately addresses project effects.

Again aside from the final determination of the actual study area, the methodology and consultation procedures for the Phase IB site identification and Phase II site evaluations studies summarized in the Study Plan are adequate except that no provision is provided to address the potential presence of deeply buried cultural deposits. The final study plan should contain procedures to evaluate the potential for buried cultural deposits as well as proposed field techniques to address the need to sample at greater depths than can be generally attained by standard survey methods.

In summary, the Division believes that the completion of the following Study Plan components is necessary to adequately address the Projects effects on cultural resources:

Wilder, Bellows Falls and Vernon Projects

- Final determination of an APE that includes a minimum of 10 meters (33 feet) of land adjacent to the top of bank adjacent to the impoundments. Phase IB site identification studies will be focused on sections of the APE where active erosion or other project effect is occurring. Phase II site evaluation studies will also be focused on sites that are within actively eroding or otherwise effected sections of the APE but ultimately should include sites defined other portions of the APE to fully identify the number and location of the historic properties within the three project boundaries (see below project specific breakouts).

- Identification of Traditional Cultural Properties

- Survey and Evaluation of Historic Architectural Resources

Wilder and Bellows Falls Projects

- Phase IB site identification within all archeologically sensitive areas and potential site locations within the APE that are actively eroding.

- Phase II site evaluation of any archeological site identified in the Project APE as a result of the Phase IB survey or any known site that is located within a portion of the APE that is actively eroding to determine their boundaries and eligibility for inclusion on the National Register of Historic Places.

- A phased plan to complete Phase II site evaluation of all remaining currently recorded archeological sites in the Project APE to determine their boundaries and eligibility for inclusion the National Register of Historic Places.

- Both Phase IB site identification and Phase II site evaluation studies must include strategies to address deeply buried cultural deposits.

- Development of a Historic Properties Management Plan for each project.

Vernon Project

- Phase IB site identification within the Project APE of all archeological sensitive areas and potential site locations that are actively eroding based on the 2013 Monitoring Report

- Phase II site evaluation of any archeological site identified in the Project APE as a result of the Phase IB survey or any known site that is located within a portion of the APE that is actively eroding to determine their boundaries and eligibility for inclusion on the National Register of Historic Places.

- A phased plan to complete Phase II site evaluations of all other known archeological sites in the Project APE to determine their boundaries and eligibility for inclusion in the National Register of Historic Places.

- Both Phase IB site identification and Phase II site evaluation studies must include strategies to address deeply buried cultural deposits.

- Development of a revised Historic Properties Management Plan.

The above studies and development/revision of the Project specific HPMP's will provide the basis for the development of any Mitigation Plans and Programmatic Agreements to address any adverse effects to historic properties. Completion of these actions will ensure that the Projects relicensing fully considers potential impacts to historic properties in compliance with the National Historic Preservation Act.

Thank you for your cooperation in protecting Vermont's irreplaceable historic and archeological heritage. R. Scott Dillon reviewed this project and prepared this letter. I concur with the findings and conclusions described above.

Sincerely:
VERMONT DIVISION FOR HISTORIC PRESERVATION

Judith W. Ehrlich

for Noelle MacKay
Acting State Historic Preservation Officer

Cc: John Ragonese, TransCanada
Elizabeth Muzzey, NH SHPO
Ed Bell, MA SHPO

TRANSCANADA HYDRO NORTHEAST INC.

Wilder Hydroelectric Project (FERC Project No. 1892-026)
Bellows Falls Hydroelectric Project (FERC Project No. 1855-045)
Vernon Hydroelectric Project (FERC Project No. 1904-073)

Revised Study Plan

Appendix E

Written Comments and Requests Response Summary

August 14, 2013

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Study 1 – Historical Riverbank Position and Erosion Study

Commenter	Comment	Response
CRJC	These studies [#s 1, 2 and 3, Historical Riverbank Position and Erosion, Riverbank Transect Study, and Riverbank Erosion Study] as proposed, will describe erosion at diverse locations above and below the three dams but they may be insufficient to determine what proportion of that erosion is directly attributable to dam operations…Expand the number of erosion study sites, particularly, in the Bellows Falls and Vernon impoundments to ensure a more complete range of erosion conditions are evaluated. Include at least five additional study sites in the Bellows Falls and Vernon impoundments. These studies should also be undertaken during high, low and transitioning water levels in order to more effectively evaluate the contribution of fluctuating water levels on erosion. Finally, in order to better assess the effect of project operations, we recommend a geotechnical slope stability analysis be conducted at each of the proposed study sites.	We note that Study 1 - Historical Riverbank Position and Erosion is not a field based study, but rather a literature and document review that will inform Studies 2 and 3. Studies 2 and 3 include provisions for comprehensive evaluations of erosion throughout the project-affected areas and during conditions beyond that which are affected by project operations. Provisions are included in the plans for working group consultation during the course of the studies, which would include the need for additional sites based on field reconnaissance. We respectfully disagree that geotechnical slope stability analysis, specifically, is warranted at this time. The study plans indicate that periodic meetings will be held with the Erosion Working Group to solicit comments in order to strengthen data collection procedures, analysis of erosion causes, and continuing studies during the two-year study period.
CRWC	CRWC has no further comment as the updated draft of Study plan 1 incorporates the CRWC suggestion that along with other research that there will be direct landowner outreach.	Study plan revisions reflect stakeholder consultation meetings and discussions held during 3-month comment period.
City of Lebanon	The City will provide our available digitized aerial and historic maps in support of the Erosion and other studies.	We appreciate the material and will work with the City to review pertinent information for this study.

Commenter	Comment	Response
NHDES	p. 17, Analysis. It is stated that this study will attempt to correlate bank loss to a specific period or time frame, historical hydrological events, or other causal agents. NHDES requests that "other causal agents" include historical changes in the operation of the three projects. This information should provide further insight as to how project operations have potentially affected riverbank erosion.	The study plan has been revised to state: "The analysis of potential causal agents will include an investigation of whether flood frequency, project operations, tributary inputs, or other conditions (e.g., bank armoring) have changed during periods and at locations where significant erosion has been identified. Correlations between erosion and other changes along the river could potentially identify the causes for erosion; however, there have been no historic changes in operations since minimum flows were established in mid-1970's."
VANR	TransCanada proposed study plan in the Analysis section (pg. 17) indicates that the licensee will try to correlate historic bank loss to a specific period or time frame, historic hydrological events, or other causal agents. The Agency recommends that added to possible causal agents or specific periods when changes in operations occurred at the projects (i.e. increase operational capacity, change in impoundment elevation or management). Including this information in the correlation analysis will give the Agency a better idea of how project operations potentially are affecting the rate and type of riverbank erosion on the river.	The study plan has been revised to state: "The analysis of potential causal agents will include an investigation of whether flood frequency, project operations, tributary inputs, or other conditions (e.g., bank armoring) have changed during periods and at locations where significant erosion has been identified. Correlations between erosion and other changes along the river could potentially identify the causes for erosion; however, there have been no historic changes in operations since minimum flows were established in mid-1970's."

Study 2 – Riverbank Transect Study

Commenter	Comment	Response
CRJC	These studies [#s 1, 2 and 3, Historical Riverbank Position and Erosion, Riverbank Transect Study, and Riverbank Erosion Study] as proposed, will describe erosion at diverse locations above and below the three dams but they may be insufficient to determine what proportion of that erosion is directly attributable to dam operations…Expand the number of erosion study sites, particularly, in the Bellows Falls and Vernon	We note that Study 1 - Historical Riverbank Position and Erosion is not a field based study, but rather a literature and document review that will inform Studies 2 and 3. Studies 2 and 3 include provisions for comprehensive evaluations of erosion throughout the project-affected areas and during conditions beyond that which are

Commenter	Comment	Response
	impoundments to ensure a more complete range of erosion conditions are evaluated. Include at least five additional study sites in the Bellows Falls and Vernon impoundments. These studies should also be undertaken during high, low and transitioning water levels in order to more effectively evaluate the contribution of fluctuating water levels on erosion. Finally, to better assess the effect of project operations, we recommend a geotechnical slope stability analysis be conducted at each of the proposed study sites.	affected by project operations. Provisions are included in the plans for working group consultation during the course of the studies, which would include the need for additional sites based on field reconnaissance. We respectfully disagree that geotechnical slope stability analysis, specifically, is warranted at this time. The study plans indicate that periodic meetings will be held with the Erosion Working Group to solicit comments in order to strengthen data collection procedures, analysis of erosion causes, and continuing studies during the two-year study period.
CRWC	There is legitimate concern that daily reservoir level fluctuation causes piping of water in and out of a saturated bank, piping that would be an important contributor to the erosion problems landowners are experiencing in the impoundment areas. Ongoing monitoring would capture data on such effects. The draft plan now says that TC will meet with the working group to discuss increasing monitoring. The plan should say that the ongoing bi-weekly site review will continue to take place throughout the study period and that TC will meet with the working group to see if there is any reason to stop the ongoing monitoring. The study plan should include the 18 ongoing monitoring sites requested by NHDES, VANR and NHFG.	The study plan has been revised to include consultation with the erosion working group and consideration of increased monitoring based on initial surveys and any information gleaned from the historic data research in Study 1 - Historical Riverbank Position and Erosion that supports the need for more periodic monitoring based upon significant erosion rates.
City of Lebanon	The City is reviewing areas of concern along the City's stretch of the river for potential transect locations for the Riverbank Transect Study and the Riverbank Erosion Study. We understand that the same transects will be used in both studies and that additional transects could be added.	The study plan has been revised to include consultation with the erosion working group. We propose that sites be selected by October 15 2013, so there is enough time to complete the monitoring before winter and would request that the City of Lebanon provide their recommendations before the as yet unscheduled working group meeting in early October.
NHDES	p. 19, Study Goals and Objectives, 1st paragraph. This section states that the goal is to monitor riverbank erosion at selected sites in the impoundments and	The study plan’s goals and objectives have been revised to include the 1.5 mile section below Vernon dam, specified in other studies. The site on the NH

Commenter	Comment	Response
	project-affected riverine sections below the Wilder and Bellows Falls dams. This sentence should be revised to include sites up and downstream of the Vernon dam which would be consistent with p. 21, Study Area and Study Sites, where it is stated that 4 transects associated with the Vernon dam will be monitored.	bank immediately below Vernon dam has been monitored for many years and information from that on-going monitoring will be included in some manner in this study.
NHDES	p. 22, Establishing Monitoring Sites and Repeat Surveys. The accuracy of the topographic, bathymetric and repeat surveys should be specified. It is stated that data will be collected at sufficient density to accurately describe the slope geometry. This should be specified. The density will need to be quite high to detect changes in riverbank geometry that may be primarily attributable to project operation. In its study request, NHDES proposed installation of horizontal pins into the bank to help measure erosion over the short and long term. If the density of survey points is not considered high enough to detect subtle changes in riverbank geometry, NHDES will likely request that pins be installed as described in its original study request.	The study plan has been revised to specify accuracy. With regard to density, the density of survey data will discern erosion amounts of 0.1 ft or less over all, or even a small portion, of the bank height. In addition, survey points will be taken at every marked change in bank slope with at least 10 survey points to be measured from the top to bottom of the bank. Installation of horizontal pins can disturb soil in such a way that alters local erosion. The detailed topographic surveys using an electronic total station as proposed in the study plan would provide more reliable measures of erosion rates.
NHDES	p. 22 and p 23, Repeat Surveys. On p.22 it is stated that surveys at the 20 sites will be resurveyed and ground photographs retaken at least four times per year for 2 years. On p. 23 it is stated that while NHDES and others requested monitoring of several bank transects on a biweekly basis for one year at 18 monitoring stations (three in each impoundment and three downstream of each dam), this additional monitoring is not incorporated into this study as such information will only be valuable if active soil loss occurs nearly continuously throughout the year. This assumes that soil loss is not occurring continuously with no data to support this assumption. To determine if soil loss is occurring nearly continuously and to help isolate the potential effects of daily project operation	The study plan has been revised to include consultation with the erosion working group and consideration of increased monitoring based on initial surveys and any information gleaned from the historic data research in Study 1 - Historical Riverbank Position and Erosion that supports the need for more periodic monitoring based upon significant erosion rates.

Commenter	Comment	Response
	on riverbank erosion and instability NHDES requests that biweekly surveys be conducted throughout the year as originally proposed in our study requests.	
NHDES	p. 23, Surface Water Level Monitoring. The accuracy of the pressure transducers used to measure water levels should be specified. This section also states that the pressure transducers will be removed during the winter months to avoid breakage but that since flow variation is generally limited in the winter months, the absence of data collection in the winter months should not alter study results. NHDES disagrees that the absence of water level data in the winter months will not alter results. As shown in the figure provided in our study request that is based on data from the USGS gage located downstream of the Bellows Falls Project in North Walpole, water levels due to project operation fluctuated significantly in January 2013. The study plan should therefore address how water level fluctuation in the river during the winter will be accounted for and how it could potentially impact erosion along the riverbank.	The study plan has been revised to specify that transducers will be set to automatically record water levels at 15-minute intervals and will be able to measure changes in water levels with an accuracy of 0.02 ft. We note that the study plan reference (removed from the revised plan) to winter flow variation would have been more correctly stated as "flow variation ***outside of the daily project operations*** is generally limited in the winter months due to frozen precipitation." Winter daily normal operations will not be very different from other periods in the year in terms of the range of elevation changes and flows, so the absence of data collection in the winter months should not alter study. In addition, we are concerned about damage to stilling wells and monitors from icing during winter and propose to remove monitors during the first winter. However, the study plan has been revised to allow for leaving monitors in during the second winter at up to 6 sites (one upstream and one downstream of each dam) where no damage to stilling wells occurred during the first winter. In addition, the modeling in Studies 4 and 5 will develop stage flow relationships that are equally applicable throughout the year will describe how water levels fluctuate throughout the reservoirs and downstream reaches - at erosion sites and other resource areas.
VANR	A minimum of six select sites (three in the impoundment and three downstream of the dam) for each project was requested…[and] that surveys be conducted biweekly for a period of one year, at each of the 18 sites. However, the licensee is proposing that	There currently is no information on rates of erosion that supports the significant effort associated with monitoring sites on a 2-week interval. The study plan is intended as a starting point to gather such information.

Commenter	Comment	Response
	surveys will occur at least four times per year for 2 years, including immediately after high spring flows, early and late summer, and then in late fall with additional surveys conducted within 15 days of any significant high water event (monitoring trigger flow to be determined after review of exceedance curves of natural inflows). In their study plan, the licensee states that the additional monitoring is not incorporated into this study as such information will only be valuable if active soil loss occurs nearly continuously throughout the year. Therefore, the licensee is assuming that erosion is not occurring continuously as a result of daily peaking operations and water level management in the impoundments. Monitoring more frequently would provide a control (look at things in the absence of high flow events), and continuously because flow and water level fluctuations on a daily basis could slowly cause erosion to occur. The Agency also recommends that the study plan include monitoring in the winter season because of the relationship between ice scour and daily fluctuations in flow and water level. In their "TC study Meeting comments and action items -2013 06 20.doc" the licensee did provide considerations in regards to changing the monitoring frequency. The Agency requests that the licensee increase their monitoring frequency to the biweekly schedule.	However, we have revised the study plan to include consultation with the working group and consideration of increased monitoring based on initial surveys and actual evidence that rates are such that more frequent measurements would be warranted and would produce measurable results.
VANR	The licensee states in the method section of the proposed study plan under the sub-heading of Surface Water Level Monitoring (pg. 23) that "Flow variation is generally limited in the winter months, so the absence of data collection in the winter months should not alter study results." The stream flow data from the USGS gauge located in North Walpole, NH below the Bellows Falls project for winter 2013 indicates that water level	We note that the study plan reference (removed from the revised plan) to winter flow variation would have been more correctly stated as "flow variation ***outside of the daily project operations*** (*emphasis added*) is generally limited in the winter months due to frozen precipitation." Winter daily normal operations will not be very different from other periods in the year in terms of the range of elevation changes and flows, so

Commenter	Comment	Response
	fluctuations associated with project operations happens on relatively the same periodicity as in other seasons [hydrograph included]. The Agency does not agree that absence of this data collection will not alter study results. The licensee study plan should indicate how they will address water level fluctuation in the winter and how it could potentially affect riverbank erosion.	the absence of data collection in the winter months should not alter study. In addition, we are concerned about damage to stilling wells and monitors from icing during winter and propose to remove monitors during the first winter. However, the study plan has been revised to allow for leaving monitors in during the second winter at up to 6 sites (one upstream and one downstream of each dam) where no damage to stilling wells occurred during the first winter. In addition, the modeling in Studies 4 and 5 will develop stage flow relationships that are equally applicable throughout the year will describe how water levels fluctuate throughout the reservoirs and downstream reaches - at erosion sites and other resource areas.

Study 3 – Riverbank Erosion Study

Commenter	Comment	Response
CRJC	These studies [#s 1, 2 and 3, Historical Riverbank Position and Erosion, Riverbank Transect Study, and Riverbank Erosion Study] as proposed, will describe erosion at diverse locations above and below the three dams but they may be insufficient to determine what proportion of that erosion is directly attributable to dam operations…Expand the number of erosion study sites, particularly, in the Bellows Falls and Vernon impoundments to ensure a more complete range of erosion conditions are evaluated. Include at least five additional study sites in the Bellows Falls and Vernon impoundments. These studies should also be undertaken during high, low and transitioning water levels in order to more effectively evaluate the contribution of fluctuating water levels on erosion.	We note that Study 1 - Historical Riverbank Position and Erosion is not a field based study, but rather a literature and document review that will inform Studies 2 and 3. Studies 2 and 3 include provisions for comprehensive evaluations of erosion throughout the project-affected areas and during conditions beyond that which are affected by project operations. Provisions are included in the plans for working group consultation during the course of the studies, which would include the need for additional sites based on field reconnaissance. We respectfully disagree that geotechnical slope stability analysis, specifically, is warranted at this time.

Commenter	Comment	Response
	Finally, in order to better assess the effect of project operations, we recommend a geotechnical slope stability analysis be conducted at each of the proposed study sites.	The study plans indicate that periodic meetings will be held with the Erosion Working Group to solicit comments in order to strengthen data collection procedures, analysis of erosion causes, and continuing studies during the two-year study period.
City of Lebanon	The City is reviewing areas of concern along the City's stretch of the river for potential transect locations for the Riverbank Transect Study and the Riverbank Erosion Study. We understand that the same transects will be used in both studies and that additional transects could be added.	The study plan for Study 2 – Riverbank Transect Study has been revised to include consultation with the erosion working group. We propose that sites be selected by October 15 2013, so there is enough time to complete the monitoring before winter and would request that the City of Lebanon provide their recommendations before the as yet unscheduled working group meeting in early October.
NHDES	p. 26 Study Goals and Objectives. Consistent with our study requests, the objectives of this study should address the following: 1. determine how water level fluctuations within the minimum and maximum operating range and discharges from peaking operations at the Wilder, Bellows Falls and Vernon hydroelectric projects contribute to shoreline erosion; 2. Identify and determine the effects of shoreline bank erosion and riverbank failure on other resources (i.e. riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat, etc.); 3. identify techniques that could be used to mitigate the effects of project operations or other mitigation techniques that could be developed to reduce on riverbank erosion within the impoundment and downstream of the tailrace.	The study plan includes an objective to "ascertain the likely causes of erosion (e.g., high flows, groundwater seeps, eddies, water level fluctuations related to project operations)". This inherently encompasses the full range of project flows and discharges. The study plan has been revised in the objectives section to clarify this objective by stating "identify the effects of project operation related shoreline erosion on other resources (e.g., riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic and terrestrial wildlife habitat). Potential techniques or operational changes that might be used to mitigate project effects cannot be determined until the study has been completed. As applicable and feasible, these will be proposed and included in the project's license applications, Exhibit E – Environmental Report.
NHDES	p. 31 Stratigraphic Descriptions, last sentence. The accuracy of the survey grade GPS should be specified.	The study plan has been revised to specify the accuracy of the GPS, in relation to known reference points, to within 0.2 ft horizontally and vertically but will depend on the distance from the base station.

Commenter	Comment	Response
NHDES	p. 33, Analysis and p. 34 Deliverables. The study should compare the water elevations due to project operation to the elevation along the riverbanks below which there is a lack of vegetation, undercutting, etc. and determine if there is a correlation. The study should also address the potential of daily project operations making the riverbanks more prone to massive erosion (i.e., due to lack of vegetation, undercutting, etc.) and how this may impact frequency and magnitude of erosion when high flows occur. The study should also address how daily project water level fluctuations may impact groundwater levels and movement within the riverbank and the extent to which this may be destabilizing the banks and making them more prone to erosion failure under higher flows. The analysis should also evaluate how changes in project operation may affect riverbank erosion along the river.	The study plan includes two objectives that address the comment including: characterizing the processes of erosion; and ascertaining the likely causes of erosion in project-affected areas. We interpret the commenter's use of the terms "high flows" and "higher flows" to refer to flows outside of the normal range of project operations. As such, evaluation of those flows is beyond the scope of this study. However, in response to the comment, the study plan has been revised to include provisions for consultation with the erosion working group on the need for additional study based on the results of this study. TransCanada is not proposing changes in project operations. The goal of this study is to assess the effects of current project operations on riverbank erosion.

Study 4 – Hydraulic Modeling Study

Commenter	Comment	Response
CRJC	This study plan, as currently proposed, does not assess the effect of climate change. The applicant's study approach entirely relies on historical stream gage data to extrapolate future flows…As an alternative to a study of climate change per se and since the proposed hydraulic model will be an important element used in fully evaluating many of the other environmental, historic and habitat impact studies, the model should be robust enough to evaluate the effects of variable flows including higher and or lower flows anticipated due to generally accepted precipitation forecasts associated with	TransCanada respectfully reiterates its position that there is no model that can accurately predict or describe future environmental climate related conditions. The selected hydrologic water years in Study 5 – Operations Modeling have significant variability that the capacity for the projects to handle or be affected by such variability will be tested and shown. Likewise the ability for the projects to adapt to such variability will also be evaluated. The results of which should enable a reasonable determination of what the projects can and cannot do in relation to environmental inputs. Lastly, unforeseen climate

Commenter	Comment	Response
	climate change. The model should have the capacity to incorporate and predict impact on river resources at the flood flow levels already part of the FERC required safety review of the dams.	change or any other environmental inputs can be addressed though existing FERC regulation and processes.
CRJC	The proposed [modeling] studies [4 and 5]…as currently presented, will not be capable of assessing the effect of the existing dams and their operations on a variety of floodplain resources…The proposed hydraulic and operations modeling studies should be capable of assessing the effect of project operations on a greater variety of significant public interests in the geographic area that would be affected by a 500-year storm. This requires delineating the lateral extent of the 500-year floodplain so that resources in this area can be inventoried. We encourage the applicant to partner with other entities to (1) develop a more robust hydraulic model (2) clearly define the elevations of the annual, 100-year and 500-year flood events, and (3) share the cost in modifying the study plan.	TransCanada respectfully disagrees. The modeling and its application in various terrestrial studies are all designed to assess project operations on floodplain resources, where those resources exist in the project-affected areas.
CRWC	The hydraulic model should have the capacity that when correlated with the other studies predict impact on river resources due to exceptional flow caused by climate change. The model should be available to planning, river resource and emergency organizations in the watershed.	The hydraulic model and the operations model are designed to evaluate current project operations and operational alternatives in relation to affected resources using a wide range of hydrologic conditions represented by five historic years of natural inflows into the Connecticut River Basin. The hydrology dataset does not specifically represent future unknown or predicted inflows based upon regional climate change models. TransCanada's position is that there are no models that can accurately predict or describe future environmental climate related conditions. The selected hydrologic water years have significant variability within which the capacity for the projects to handle or be affected by such variability will be tested and

Commenter	Comment	Response
		shown. Likewise, the ability for the projects to adapt to such variability will also be evaluated. The results should enable a reasonable determination of what the projects can and cannot do in relation to environmental inputs. Lastly, unforeseen climate change or any other environmental inputs can be addressed though existing FERC regulation and processes. It is not necessary to speculate and regulate based upon such speculation at this time. The hydraulic model is the same model that would be used in future emergency action planning and dam breach studies required by the FERC dam safety division. Once the study is complete, TransCanada will make HEC-RAS model input data files available to stakeholders upon written request.
City of Lebanon	The City strongly recommends that the Hydraulic Modeling study place additional pressure-transducers (data-logging devices) along the Lebanon portion of the mainstem, particularly downstream of the White River. Suggested locations included the Chambers/Cole reach, the Westboro reach, the White and Mascoma confluences, and the Rt. 12A reach (below 1-89).	Locations of data logger installations are included in Study 7 – Aquatic Habitat Mapping, and in Study 2 – Riverbank Transect Study. In the revised plan for Study 7, transects are located near the I-89 bridge and at the Mascoma River. There is an existing USGS gage at the mouth of the White River. These locations are sufficient to collect data that will be used in the hydraulic model. Additional transects may be placed in consultation with the various working groups for specific needs.
NHDES	p. 43, Hydraulic Model Calibration and Verification. It is stated that calibration and verification will be based on a range of observed flows and water surface elevation from USGS gages and water level logger data. Figure 4-1 on p. 40 indicates that the model will be used to predict velocities which will be used in other studies. Considering the importance of velocity on erosion, aquatic habitat, etc., NHDES recommends that calibration of the model include comparison of	The study plan has been revised to indicate that velocities measured in 2013 will be compared to average velocities computed by the HEC-RAS model, as available and applicable.

Commenter	Comment	Response
	predicted velocities at several cross sections to measured velocities.	
NHDES	p. 44. Sub-Hourly Flow and Elevation Rate-of-Change. It is stated that 5 modeling scenarios of 24 hours each will be run. The study plan should reflect that additional runs may be needed depending on the results and comments received from the reviewing agencies.	The study plan has been revised to include provisions for additional model runs as applicable, based on model results, results and needs of other resource studies and working group comments.
TNC	Deliverables: On page 47, TransCanada presents a brief description of the report that will be prepared for the hydraulic study. We request that the following specific components be included in the report or provided upon request: • The HEC-RAS files necessary to run the models and reproduce the results, including the geometry files, plan files, flow files, and project files (i.e., file extensions .f, .g, .O, .p, .prj, and .r); • The associated GIS files with topographic data for the valley and stream cross sections; and • A brief summary of the approach taken to calibrate the model including the data used and assumptions made.	Once the study is complete, TransCanada will make HEC-RAS model input data files available to stakeholders upon written request. HEC-RAS input data does not include topographic contour datasets or LiDAR data, which is unnecessary for running and reproducing the model results. We will describe calibration methods and results in the draft and final study reports.

Study 5 – Operations Modeling Study

Commenter	Comment	Response
CRJC	The proposed [modeling] studies [4 and 5]…as currently presented, will not be capable of assessing the effect of the existing dams and their operations on a variety of floodplain resources…The proposed hydraulic and operations modeling studies should be capable of assessing the effect of project operations on a greater variety of significant public interests in the geographic area that would be affected by a 500-year storm. This requires delineating the lateral extent of	TransCanada respectfully disagrees. The modeling and its application in various terrestrial studies are all designed to assess project operations on floodplain resources, where those resources exist in the project-affected areas.

Commenter	Comment	Response
	the 500-year floodplain so that resources in this area can be inventoried. We encourage the applicant to partner with other entities to (1) develop a more robust hydraulic model (2) clearly define the elevations of the annual, 100-year and 500-year flood events, and (3) share the cost in modifying the study plan.	
FWS	The plan proposes to define econode relationships with flows and downstream node elevations using output from the hydraulic model. To ensure accuracy, the hydraulic model cross-sections and the Vista model econodes should be at the same location. The updated PSP is not clear on the relationship between these locations. At the study plan meetings, there were discussions pertaining to the development of a two-dimensional rating curve for "interzone" areas where there is a transition from ponded to riverine conditions, so that the relationship between upstream and downstream project operations could be assessed. In addition, there was discussion on the use of an optimization model to run various operation scenarios. Neither of these concepts are included in the updated PSP, but should be discussed and included in the final plan.	The study plan has been revised to clarify this point. Cross sections and elevation logging hobos are located to assist in developing an accurate hydraulic model, and to accurately characterize locations of interest to the resource studies (econodes) in Study 2- Riverbank Transect Study, Study 4 – Hydraulic Modeling, and in Study 7 – Aquatic Habitat Mapping. Econodes defined in this Vista DSS model are as defined by the resource areas identified through studies. While not required to accurately define the hydraulic conditions at each econode, most will also have cross sections and elevation data loggers at the same location. The study plan has been revised to define the inter-zone rating curve. The study plan has also been revised to clarify the use of the operations model and hydraulic model to examine alternative operations that may be identified through resource working group discussion of study results as a potential means to mitigate or enhance resources affected by project operations.
FWS	At the study plan meetings, we requested the model data set. The Vista model is proprietary, but TransCanada indicated that the HEC-RAS input hydrology set would be provided. This should be clarified in this section of the updated PSP.	The study plan has been revised to state: "Study related data will be made available to stakeholders upon written request but the Vista DSS ™ is proprietary so data input and output will be provided but not the actual model. HEC-RAS model input data files will also be provided upon written request."
William and Jennifer	At the May 16th TransCanada and FERC meeting in White River Junction, TransCanada Project Manager	The study plan identifies the purpose of the operations model as a tool to evaluate existing operations on

Commenter	Comment	Response
Lipfert	John Ragonese stated that "only one operational alternative will be studied." When queried about this unusual stance, given that the National Environmental Policy Act calls for all "reasonable alternatives" to be studied, Mr. Ragonese stated "If we find any problems with the results of any of the studies, we'll go back and add alternatives later." Mr. Ragonese rejected our formal request for the inclusion of a second operational alternative in the studies. This second operational alternative would limit the rate of change of outflow of the dams, such that the transition from minimum flow to maximum flow would take place over the course of some minutes – rather than the current operational practice of a near-instantaneous change. Our concern stems not from any particular flow rate assumed in the studies but, rather, from the lack of any operational alternatives that address reasonable limitations in rate of change in flow. We request that TransCanada be requested to add a second operational alternative, one with a limitation in rate of change in flow of 5000 cfs per hour (that is, requiring the operator to transition from minimum flow to full hydraulic capacity over two hours when practicable to do so). We believe TransCanada's suggestion that it will revisit operational alternatives at a later date should study results warrant to be inconsistent with NEPA.	various resource issues and concerns. The model also has the capacity to evaluate alternative operational scenarios and their potential to mitigate effects on resources. We expect to run operational scenarios as needed to evaluate potential effects on a variety of resources (e.g., erosion, fisheries and aquatics, terrestrial) based upon discussions and proposals put forth through working group discussion of resource study results that examine existing operational impacts.
NHDES	The study request submitted by NHDES requested that modeling be conducted to evaluate the potential effects of climate-altered flows on project operations over the course of the license. TransCanada's proposal does not address this objective, but should. Given studies such as those by researchers at the University	TransCanada respectfully disagrees. The hydraulic model (study plan 4) and the operations model (study plan 5) are designed to evaluate current project operations and operational alternatives in relation to affected resources, using a wide range of hydrologic conditions represented by five historic years of natural

Commenter	Comment	Response
	of New Hampshire that show that flood and drought frequency in New Hampshire has changed over the past 40 years, and is very likely to continue to change, climate change scenarios are necessary. Much of this type of modeling is already underway around the state, though not in the Connecticut River. NHDES requests that TransCanada address how they will evaluate the potential effects of climate-altered flows on project operations over the course of the license in their study plan.	inflows into the Connecticut River Basin. The hydrology dataset does not specifically represent future unknown or predicted inflows based upon regional climate change models. TransCanada's position is that there is no model that can accurately predict or describe future environmental climate related conditions. The selected hydrologic water years have significant variability that the capacity for the projects to handle or be affected by such variability will be tested and shown. Likewise the ability for the projects to adapt to such variability will also be evaluated. The results of which should enable a reasonable determination of what the projects can and cannot do in relation to environmental inputs. Lastly, unforeseen climate change or any other environmental inputs can be addressed though existing FERC regulation and processes. In summary, it is neither appropriate nor necessary to speculate and regulate based upon such speculation at this time.
NHDES	It is stated that a 5 year subset of the available 30 years of inflow were selected based on the annual and spring inflow volumes at Vernon and the annual energy production. The study should clarify if the rankings are based on 1 being the lowest or highest inflow volume or annual energy production. To better predict long term continuous impacts, it would be better to run all 30 years rather than a 5 year subset. It would seem that once the various relationships in the model are set up, it would not be difficult to run the model for all 30 years. Based on this understanding, NHDES requests that this be done.	The study plan has been revised to state: "The selection was based on ranking annual and spring total inflow volumes at Vernon and the system annual energy production from the lowest (1) to the highest (30) and searching for seasonal variability between the five selected hydrologies" The study plan has been revised to clarify the rationale for not running the model for all 30 years, as follows: "Information on operational impacts can be well provided by a properly selected representative subset of the hydrology. The selected subset represents a range of flow conditions both annually and seasonally. The subset also represents a wide range of annual energy production and thus reflects the actual TransCanada interference in the river regime."

Commenter	Comment	Response
		Modeling all 30 years is unnecessary based upon the reasons stated above. Furthermore it is impractical and expensive in terms of the additional clarity or insight gained due to the significant increase in model run times and post-processing, as well as the massive amounts of data and analysis associated with each operational scenario needed to tease out critical impacts to a particular hydrology at every eco-node.
NHDES	Our interpretation of this section is that [sub-hourly] model runs assuming different project operation will only be run if the erosion, aquatic and terrestrial groups raise concerns based on model results assuming current project operations. One of the objectives in our study request was to compare hourly discharge and water surface elevations at various locations at current and proposed operating conditions to model results assuming instantaneous run-of-river at the Projects. Running the model assuming instantaneous run-of-river will help place bounds on the possible range of results and provide a relative idea of the sensitivity of the model. NHDES therefore requests that this scenario be run.	Similar to the model using an hourly time-step, a sub-hourly model will first examine current operating procedures to identify resource impacts on a resource of concern (referred to as the base case). Such sub-hourly examinations will focus on discharge rates of change or flow changes over a finite period. In the event that the rate of change of water level and/or flow at the downstream econodes in the sub-hourly base case scenario is judged to be problematic to a specific reach or resource, an alternative unit loading/unloading policy that would affect the rate and magnitude will be analysed in a similar sub-hourly time-step.
TNC	On p. 53, TransCanada states that each year of the 5-year subset used for model inflows corresponds to a particular ranking of annual flow volume at Vernon and to a particular ranking of annual system energy production. We request that TransCanada please clarify whether these rankings are ascending or descending. In other words, does a ranking of 30 correspond to the largest value of annual inflow or energy production, or to the lowest value? In addition, it is not clear how the ratio of spring total inflow to annual inflow volume is different among the five years. If the selection was based on both annual and spring total inflow volumes at Vernon, and represents	The study plan has been revised to clarify the rationale for not running the model for all 30 years, as follows: "information on operational impacts can be well provided by a properly selected representative subset of the hydrology. The selected subset represents a range of flow conditions both annually and seasonally. The subset also represents a wide range of annual energy production and thus reflects the actual TransCanada interference in the river regime." The study plan has been revised to state: "The selection was based on ranking annual and spring total inflow volumes at Vernon and the system annual energy production from the lowest (1) to the highest

Commenter	Comment	Response
	different seasonal patterns as well as a range of overall hydrology inflow, it would be helpful to know the rank of each year relative to spring total inflow volumes as well. Additionally, we request that TransCanada please explain or clarify how the operational impact of subsequent wet or dry years will be evaluated if only one year is run through the model at a time.	(30) and searching for seasonal variability between the five selected hydrologies" We note that the three projects are not annual storage projects – they are daily storage projects and so the impacts of annual differences or continuation of wet or dry conditions is immaterial to these projects specifically. In addition, the upstream storage reservoirs that have seasonal drawdowns are of such size relative to their respective watersheds that they have never failed to re-fill in the spring runoff season.
TNC	On p. 54, TransCanada provides some explanation of the rationale and methods for defining hourly market energy prices. The text states, "…the 2010 hourly prices were filtered by deriving the average hourly weekday and weekend prices for each month for use in the model." Does this mean that there are only two derived values associated with each month: a weekday value and a weekend value? We request that additional detail be provided to clarify the filtering process, perhaps by including the steps used to develop the energy price signals.	The study plan has been clarified to address this point. The filtering is done by averaging each weekday-hour value (and each weekend-hour value) with all values available in the month. For example, the January Monday to Friday 10 am price is taken as the average of the 23 values that occur in that month. Similarly, the January Saturday and Sunday 10 am price is taken as the average of the 8 values that occur in that month Thus there is an hourly pattern over the week, which is then applied throughout the month. This provides representative hourly patterns for each day, while eliminating sporadic deviations.
VANR	The Agency's study request specifically requested that a model be developed to look at climate-altered flows on project operations over the course of the license. The licensee's proposed study plan currently does not address this objective. The proposed model will model project operations in five non-consecutive years selected from the past 30 years ranked from driest to wettest. This approach does not capture how project operations and river flows will be affected during consecutive wet or dry years. Additionally, the model does not capture any extreme climate and precipitation events that are predicted to increase in frequency with the onset of climate change, and how these will impact project operations or energy	TransCanada respectfully disagrees. The hydraulic model (Study 4) and this operations model (Study 5) are designed to evaluate current project operations and operational alternatives in relation to affected resources, using a wide range of hydrologic conditions represented by five historic years of natural inflows into the Connecticut River Basin. The hydrology dataset does not specifically represent future unknown or predicted inflows based upon regional climate change models. TransCanada's position is that there is no model that can accurately predict or describe future environmental climate related conditions. The selected

Commenter	Comment	Response
	production [e.g., if extreme precipitation events increase in frequency resulting in more frequent tripping of the stanchion bays at the projects]. The Agency request that the licensee address the issue of climate-altered flows on project operations over the course of the license so that the Agency can better assess the potential impacts on the river ecosystem and water quality from project operations.	hydrologic water years have significant variability that the capacity for the projects to handle or be affected by such variability will be tested and shown. Likewise the ability for the projects to adapt to such variability will also be evaluated. The results of which should enable a reasonable determination of what the projects can and cannot do in relation to environmental inputs. Lastly, unforeseen climate change or any other environmental inputs can be addressed through existing FERC regulation and processes. In summary, it is neither appropriate nor necessary to speculate and regulate based upon such speculation at this time.

Study 6 – Water Quality Monitoring Study

Commenter	Comment	Response
CRJC	We recommend that Water Quality Study Plan #6 be amended to sample sediments and fish tissue for mercury and dioxin within the project area. The goal of this sampling will be to identify mercury levels in the three reservoirs, and inform possible mitigation measures. The cost for this study modification is modest in relation to the impact mercury has on human health.	Although stated as an amendment, We consider this to represent a new study request and it was not expressed in terms of addressing the seven ILP Study requirements. TransCanada respectfully disagrees that this additional sampling is warranted for the following reasons: 1. The atmospheric deposition of mercury and subsequent bio-accumulation in fish tissue is a known problem in all freshwater bodies in both VT and NH. Statewide advisories currently exist to warn the public about eating freshwater fish. No new information is necessary to address the relevant public interest. Our view is that this request does not adequately meet ILP Study Criterion 4. 2. There is no evidence that the operation of the projects affects the bio-accumulation of mercury and dioxin in fish tissue. The three projects are operated in a daily run-of-river

Commenter	Comment	Response
		mode where inflows are not stored for any significant period of time, but are typically passed through within 24 hours. Since the baseline for assessing project effects is current operations and no change in operation is proposed at this time. Our view is that this request does not adequately meet ILP Study Criterion 5. We note that neither state water quality regulatory agency with jurisdictional authority has requested such a study (ILP Study Criterion 2).
CRJC	Amend the Water Quality Study Plan #6 to acknowledge that wetlands need to be monitored to ensure they are not degraded.	We note that monitoring of wetlands is included in Study 27 – Floodplain, Wetland, Riparian and Littoral Habitats. That study will identify and map all wetlands that are hydraulically connected to project operations. Water level and temperature monitoring will be conducted at a subset of wetlands to be identified for further field work. Long-term monitoring is not proposed under the study plan as that would be considered a mitigation or management plan not a study.
CRWC	CRWC called for temperature monitoring from April to November in order to gain a better understanding of potential project effects, especially coupled with the water temperature increases due to Vermont Yankee. TC [should] place more than one temperature logger transect above the Vermont Yankee discharge and more than one between the Entergy discharge and the Vernon dam in order to better differentiate between potential impacts of Vermont Yankee and TransCanada on water temperature.	The study plan has been revised to include temperature monitoring at all monitoring stations from April 1 or as soon thereafter as it is safe to deploy monitors, through November 15 or slightly sooner if it is expected to become unsafe to collect additional data. TransCanada respectfully disagrees that additional monitoring stations are required for this study at the sites requested. At Vernon, monitoring station V-02 will be located at river mile 154.1, and V-01 will be located in the Vernon forebay. However, the study plan has been revised to include an array of temperature monitors (several horizontal locations, each with 3 vertical monitors) deployed across the

Commenter	Comment	Response
		Vernon forebay and portions of the spillway to assess if and how river water temperature may shift during various generation conditions and spill events.
City of Lebanon	The White and Mascoma rivers will be included among the tributaries in the Operations Modeling study and the Mascoma River is among the 10 major tributaries that will be monitored at their respective confluences with the mainstem under the Water Quality study.	We concur, and the study plan has been revised to include those rivers in the tributary water temperature monitoring portion of this study.
NHDES	General: The information in this study includes some, but not all, of what is typically required in a sampling and analysis plan. DES requests that the Applicant submit a detailed sampling and analysis plan to NHDES for approval that includes quality assurance provisions, to ensure the data will be useable for water quality standards attainment decisions.	The study plan presently includes a general section on quality control and quality assurance. The study plan has been revised to state that TransCanada will submit for approval to VANR and NHDES, a detailed sampling and analysis (S&A) plan consistent with the FERC-approved study plan prior to implementation of the study. The S&A plan will include all elements of water quality monitoring described in the study plan and more detailed quality assurance descriptions as requested in the comment.
NHDES	p.62, Table 6-1 Summary of water quality station locations, 2014. This indicates that the most downstream data logger (V-TR) is at RM 141.8 which is less than two tenths of mile downstream of the Vernon Dam. It is our understanding that TC (and/or FirstLight) will conduct water quality monitoring further downstream to the NH/MA border. Additional stations should be added to the study to ensure that more of the approximate 5.5 mile reach from the Vernon Dam to the NH/MA border is monitored.	Our water quality monitoring approach for the Vernon project is similar to that for the Wilder and Bellows Falls projects, where monitoring downstream of the dam occurs in the tailrace. According to FirstLight's updated Proposed Study Plan, they will be monitoring water quality at two stations between our V-TR station and the NH/MA border.
NHDES	p. 63, Figure 6-1. The plan showing the locations of the monitoring stations is illegible. A larger scale plan, as well as aerial photos of each sampling station (mainstem and tributaries) and the approximate water depth at each proposed sampling location should be provided with the sampling and analysis plan.	The study plan has been revised to add the approximate depths of nine stations where vertical water quality profiles were sampled during 2012, but the depth of the remaining seven mainstem stations in this study and those in the 10 tributaries where water temperature will be monitored cannot be estimated until those locations are established in the field. The study plan has been revised to state that

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		TransCanada will submit for approval to VANR and NHDES, a detailed sampling and analysis (S&A) plan consistent with the FERC-approved study plan prior to implementation of the study. The S&A plan will include all elements of water quality monitoring described in the study plan, including approximate water depths and more detailed mapping of station locations as requested in the comment.
NHDES	p. 64, Methods, 1st paragraph. It is stated that turbidity probes will be added to the mainstem Connecticut River multi-parameter datasondes. As stated in our study requests, placement of turbidity data loggers should also be coordinated with other studies regarding erosion. For example data loggers located closer to the river bank will be more likely to capture potential plumes associated with erosion. Data loggers should be placed near shore just below the lower operating elevation of the projects and up and downstream of reference sites (i.e. sites with little potential for erosion) and sites with a higher potential for erosion. NHDES requests that this be addressed in the study. Data collected in this manner will help identify the impact of project operations on sediment movement/ erosion in the Connecticut River.	TransCanada respectfully disagrees that placement of additional turbidity data loggers beyond those proposed is appropriate for this study. The study plan has included turbidity measurements with its multi-parameter probes. Other studies (Study 2 – Riverbank Transect Study and Study 3 – Riverbank Erosion Study) will evaluate erosion in the Connecticut River and ascertain the impact of project operations. In addition Study 8 – Channel Morphology and Benthic Habitats Study will help to identify the effects of project operations on sediment transport as it relates to aquatic habitat.
NHDES	p.64, Methods. In order to compare results to NH surface water quality criteria for dissolved oxygen in impoundments, and as stated in our study requests (25a, 25b, 25c), "Data loggers deployed in the impoundment should be set at the bottom of the epilimnion (if stratified) or at 25% depth if not stratified. A vertical dissolved oxygen and water temperature profile should be conducted at the time of deployment of data loggers in the impounded section to determine if river is stratified and thus the appropriate depth for deployment." This should be included in the sampling and analysis plan.	The study plan has been revised to describe the depth of the deployed datasondes that will measure dissolved oxygen and to state that TransCanada will submit for approval to VANR and NHDES, a detailed sampling and analysis (S&A) plan consistent with the FERC-approved study plan prior to implementation of the study. The S&A plan will include all elements of water quality monitoring described in the study plan, including details on data logger deployment as requested in the comment.
NHDES	p.67, Quality Assurance and Quality Control	The study plan has been revised to state that

Commenter	Comment	Response
	Procedures and Objectives. The study does not specify the accuracy of all field monitoring equipment, or the laboratory methods and reporting limits for nitrate/nitrite, Kjeldahl nitrogen, total phosphorus and chlorophyll-a. This information should be included in the sampling and analysis plan.	TransCanada will submit for approval to VANR and NHDES, a detailed sampling and analysis (S&A) plan consistent with the FERC-approved study plan prior to implementation of the study. The S&A plan will include all elements of water quality monitoring described in the study plan including equipment accuracy, laboratory methods and reporting limits as requested in the comment.
NHDES	p 68, Instrument Calibration and Frequency, 1st paragraph, 1st sentence. This section states that calibration will be per the manufacturer's instructions. The calibration standards for dissolved oxygen (we calibrate to saturation and zero dissolved oxygen), pH, turbidity, specific conductance, and temperature should be included in the sampling and analysis plan. p.68, Instrument Calibration and Frequency, 1st paragraph, 2nd sentence. This section indicates that the sondes at the continuous stations will only be checked halfway through the 10-day low flow period. This appears to contradict the second paragraph on p. 65 which states the continuous monitors will be maintained, calibrated and data downloaded on a weekly basis. All continuous monitors (not just those deployed for the 10-day low flow monitoring) should be maintained, calibrated, and data downloaded at a least every week. The study plan should be revised accordingly.	The study plan has been revised to state that TransCanada will submit for approval to VANR and NHDES, a detailed sampling and analysis (S&A) plan consistent with the FERC-approved study plan prior to implementation of the study. The S&A plan will include all elements of water quality monitoring described in the study plan including details on instrument calibration as requested in the comment. The study plan has also been revised to clarify that when conditions allow, we will attempt to conduct weekly calibration and downloading of all datasondes used to measure dissolved oxygen will occur, and data will be downloaded from water temperature data loggers at approximately biweekly intervals. Actual download frequency will be based on several factors (e.g., flows, study schedules, weather conditions, crew safety)
NHDES	p. 69, Analysis. It is stated that results will be compared to impoundment elevation. Results at all stations (not just the impoundment stations) should be compared to water surface elevation measured at or near each station. Also, the sampling and analysis plan should specify how flow in the bypass reach will be determined for the duration of the water quality study.	The study plan has been revised to clarify that results from all stations, not just impoundment stations, will be compared to water surface elevations. The study plan has been revised to state that TransCanada will submit for approval to VANR and NHDES, a detailed sampling and analysis (S&A) plan consistent with the FERC-approved study plan prior to implementation of the study. The S&A plan will include

Commenter	Comment	Response
		all elements of water quality monitoring described in the study plan including a description of how flows in the Bellows Falls bypassed reach will be determined, as requested in the comment.
NHDES	p. 70. Schedule. Monitoring is proposed for 2014. The study plan should reflect that if river flows in 2014 do not include representative low flow, high temperature conditions, additional monitoring will likely be necessary in 2015.	We will rely on the ILP regulations and defer to FERC in addressing anomaly conditions requiring an additional study year. Throughout the study, consultation will occur, and progress reports and the draft study report will be shared with the working group.
NHFG	Temperature should be monitored from April to November in order to gain a better understanding of potential project effects, especially with potential water temperature increases due to Vermont Yankee. Additionally, more temperature loggers should be placed above and below the Vermont Yankee discharge in order to differentiate between potential impacts of Vermont Yankee and TransCanada on water temperature and subsequently on the results of other studies that may be dependent on water temperature (for example, downstream migration of juvenile American shad).	The study plan has been revised to include continuous water temperature monitoring at all monitoring stations from April 1 or as soon thereafter is safe to deploy monitors, through November 15 or sooner if it becomes unsafe to collect additional data. In addition, the study plan has been revised to include an array of temperature monitors (several horizontal locations, each with 3 vertical monitors) deployed across the Vernon forebay and portions of the spillway to assess if and how river water temperature may shift during various generation conditions and spill events.
VANR	The licensee has proposed in their study plan to continuously monitor temperature from June 1 through September 30. The Agency requested that continuous temperature monitoring be done from April 1 through November 15 or when conditions are safe for the field crew to deploy the temperature loggers….The continuous monitoring of temperature during this time it is an important factor in determining the effects the projects impounding water on a daily basis are potentially having on the timing of migratory fish runs and spawning…. Additionally, the Vermont Water Quality Standards state that the change in temperature either upward or downward shall be controlled to ensure full support of	The study plan has been revised to include continuous water temperature monitoring at all monitoring stations from April 1 or as soon thereafter is safe to deploy monitors, through November 15 or sooner if it becomes unsafe to collect additional data. We have reviewed the Vermont Water Quality Standards, and our study plan will attempt to evaluate and examine water quality parameters throughout the waters affected by these projects. However, we note the following: • Not all temperature changes in the project impoundments are due to project operations and therefore, we question what actually represents ambient temperature (baseline).

Commenter	Comment	Response
	aquatic biota and habitat use, as well the Connecticut River managed as a cold water fish habitat and shall not exceed 1.0°F from the ambient temperature due to the activities from the project. The Agency needs to understand how temperature of the river is being potentially affected by project operations in the spring and fall to understand how it might impact the fisheries and aquatic habitat use and timing and possible delays in fish migrations. If potential delays in fish migrations are occurring from project operations effect on temperature, the Agency reserves the right to request a more detailed study in the second year of on the temperature within the impoundments at any of the projects.	• It would appear to TransCanada that the variables responsible for temperature changes in the river are well beyond that which is either affected or mitigated by project operations. • Section 3-01.B.1.d of the Vermont Water Quality Standards allows for variations from the 1.0° F limit of temperature change by permit, and this has specifically been applied to the Connecticut River in the vicinity of the TransCanada projects.

Study 7 – Aquatic Habitat Mapping Study

Commenter	Comment	Response
CRWC	TC should conduct a literature search about river habitat conditions over time. This will allow some level of comparison of the habitat as it exists today to the habitat conditions prior to the construction of the dams.	TransCanada respectfully disagrees. ILP studies use the current project operation and facilities under the existing 1979 FERC licenses as the baseline condition, not what existed or did not exist prior to the dams being constructed. We consider this request to not meet ILP Study Criterion 5 in that the results of this proposed literature search would do nothing to inform the development of license requirements for the proposed project operation in a new license. There is no need for this information (ILP Study Criterion 4).
FWS	The updated PSP reflects changes discussed at the study plan meetings relative to mapping at high pond levels and discussion of additional water surface elevation monitoring.	The study plan revisions reflect stakeholder consultation meetings and discussions held during the 3-month comment period.
NHFG	The study plan talked about performing 1 foot contours along shorelines, but not in the main channel. They need to specify at what maximum depth they will	The study plan has been revised to clarify that 1 ft contours will be collected in shallow water habitat along the shorelines, islands and other shoal areas

Commenter	Comment	Response
	record at 1 foot contours in order to account for shallow areas away from shorelines (i.e. humps, sunken islands, etc.). I believe we talked about areas less than 10 feet at the meeting. These shallow non-shoreline areas are very important areas for fish and are locations where depth and habitat may be more impacted by small changes in pool level.	that the survey boat can access. The locations and depths of 1 ft contours will vary due to the slope of the banks, but we estimate that it will range from 4 to 6 ft deep in most shoal locations. We will collect 2 ft contours at all other depths. In very shallow areas (less than approximately 18 inches deep), the survey boat is unable to collect bathymetry or habitat data and therefore these areas will be mapped manually using GPS to create polygons around the different habitat types. Water depths will also be collected in these areas manually using GPS, an RTK unit and a stadia rod at selected transects. The manually collected data will be merged into the habitat and bathymetry shape files upon completion of the field work.
VANR	TransCanada is proposing to collect supplemental temperature data during this study using Onset Hobo water level loggers and temperature loggers as opposed to the Agency's request in the water quality study request that continuous temperature at transects located in each of the impoundments that would be collected from April 1 to November 15. In the revised study plan it is unclear if TransCanada is proposing to leave the water level and temperature loggers at the sites identified from April 1 to November 15. The licensee needs to clarify in its study plan how the duration the water level and temperature loggers will be deployed.	The study plan has been revised to clarify that water level and temperature monitoring will be conducted in project-affected areas during the summer of 2013. In 2014, data loggers will be moved to particular sites of interest for various resource studies (e.g., spawning sites, backwater and tributary sites, erosion sites, and sites needed for the two modeling studies [4 and 5]). The timing of data logger deployment and the duration of monitoring will be dependent on the needs of those resource studies, and the placement of these loggers is likely to be in shallow water that makes them vulnerable to winter ice conditions.
VANR	The licensee is proposing to validate classifications of all habitat types from side scan imagery via visual assessment within shallow water habitats and/or clear water conditions as well as pole and ponar grab samples for deeper water areas. In order to quantify the composition of substrates collected from the ponar grab, the Agency recommends that samples be brought back to the lab for further analysis. Percent composition by weight using the modified Wentworth	The study does not include quantifying the composition of substrates collected with the ponar grab during the habitat survey. We will only collect ponars in randomly selected locations in deeper water to verify the sonar images. The resolution of the sonar images is approximately 5 cm and the reason that gravel and cobble substrates will be combined in the habitat map. A single ponar from an area that may cover thousands of linear feet of habitat should not be analyzed by the

Commenter	Comment	Response
	scale would provide additional information on the aquatic benthic habitat, and would not require much more effort.	Wentworth scale and used to define the substrate composition of the entire area. The results can change every few feet would be costly and would not provide necessary and useful data (ILP Study Criteria 4 and 7).
VANR	Additionally the Agency agrees with the licensee's proposed revisions as described below [the table of meeting comments and TC responses provided for the June 20 and 21, 2013 working group conference calls].	The study plan revisions reflect stakeholder consultation meetings and discussions held during the 3-month comment period.

Study 8 – Channel Morphology and Benthic Habitats Study

Commenter	Comment	Response
CRWC	TC should conduct as part of the desktop verification work a literature search about river conditions over time. This will allow some level of a comparison of the channel morphology and benthic habitat as it exists today to the conditions prior to the construction of the dams.	TransCanada notes that Study 1 – Historical Riverbank Position and Erosion is designed to collect and evaluate information on historical river conditions as a context for evaluating erosion potential in the future. That information will be reviewed as applicable to this study. We consider the request to perform a comparative analysis of channel morphology and benthic habitat specific to conditions before and after the construction of the dams to be a new study request and it was not expressed in terms of addressing the seven ILP Study requirements. TransCanada respectfully disagrees that this additional sampling is warranted for the following reasons: 1. TransCanada fails to identify a stated goal or relevant public interest consideration for conducting such a comparison. Our view is that this request does not adequately meet ILP Study Criteria 1 and 3. 2. There is no evidence that the continued operation of the projects will affect channel morphology or benthic habitat beyond current

Commenter	Comment	Response
		operational effects. To compare pre-project conditions to post project conditions will not inform the development of future license conditions. Our view is that this request does not adequately meet ILP Study Criterion 5.
City of Lebanon	The City supports the recommendation from NHFG fisheries biologist Gabe Gries to include Mascoma River and the White River among the 6 tributaries to be selected for the channel morphology and benthic habitats in addition to 12 locations on the mainstem.	We concur and have revised the study plan to include the White and Mascoma Rivers among the tributaries considered for study, as well as the 12 mainstem locations. We will consult with the aquatics working group on all sites selected.
VANR	TransCanada's proposed study plan in the Study Area and Study Site Section (pg. 100) as proposed for study sites that are located below each of the projects to use a site at the head of the impoundment downstream as it will be a representative riverine reach of the upstream project and the impoundment. The Agency does not agree with this assumption because the sites will not [be] representative of the affects from the dam. The riverine site should be located closer to dam and before any major tributaries enter the river to be representative of the dams' impact on benthic habitat conditions. The Agency recommends that the study plan be amended to include study site just downstream of the dam.	TransCanada respectfully suggests that the comment misconstrues the meaning and intent of this statement. The study plan states "Study sites at the head of the impoundments ***may be*** [*emphasis added*] representative of both DS type and US-type study sites,.." The study plan has been clarified to indicate that there may be multiple sites between a given dam and the downstream impoundment. For example, assume that there are three sites, including 1) immediately downstream from a dam, 2) in the persistently-riverine reach downstream from a dam adjacent to a tributary, and 3) in the temporally-inundated area in the vicinity of the upstream limit of the impoundment. The first site would be suitable for evaluating effects of the upstream dam, the second site may be considered a "baseline" site, and the third site would be suitable for evaluating effects of the impoundment. Since we propose 12 mainstem sites, they can reasonably be distributed among these sub-types. In addition, the study plan has been revised to include provisions for working group consultation on selecting specific sites, which will also be based on results from

Commenter	Comment	Response
		Aquatic Habitat Mapping (Study 7), desktop preliminary site selection, and field verification, much of which will occur in 2013.

Study 9 – Instream Flow Study

Commenter	Comment	Response
CRJC	This study plan should be modified to include a determination of the flow requirements of all significant uses for which the river was designated into the New Hampshire Rivers Management and Protection Program, rather than just aquatic life…CRJC recommends that the applicant initially consult with organizations, natural resource agencies, communities and CRJC's local river subcommittees to consider all of the Instream Protected Uses, Outstanding Characteristics and Resources (IPUOCRs)listed in New Hampshire RSA 483 for which the Connecticut River was designated, in order to determine which are significant and flow dependent. This could be done using the protocols established in the Lamprey Pilot program (NHDES, 2006). Then, a determination should be made of which of these IPUOCRs have not been addressed by the applicant in other studies and warrant a full analysis of their flow requirements. These flow requirements should then be incorporated into the operations model.	All of our study plans are specifically designed to assess project operational effects on natural resources within the project affected areas. The studies will provide a broader basis for assessment than the instream flow element of the NH Rivers Management and Protection Program (NH River's Program). Additionally, VTDEC and NHDES through the stringent 401 Water Quality Certification coordinated within the ILP will result in a more efficient, effective and stringent assessment of use and impacts on resources than the NH River's Program or the proposed Pilot Program. We note that the jurisdictional state agency under the referenced State statute has not requested specific use of these "pilot" protocols. As a result, we consider this request to not meet ILP Study Criteria 3 and 6 by virtue of the fact the requestor is not the jurisdictional agency.
FWS	Dual Flow Analysis: The updated PSP includes a dual flow analysis component to assess the amount of habitat that remains suitable over a given range of project discharge flows as was recommended by the Service and other parties. TransCanada proposes to assess "some immobile aquatic species or life stages." Some species and life stages, like freshwater mussels or deposited fish eggs, are clearly	The study plan section describing dual-flow analysis has been revised to reflect that it can include other species and life stages and that determination of what species and life stages would be assessed using Dual Flow Analysis will be made in consultation with all interested parties and the aquatics working group.

Commenter	Comment	Response
	immobile or otherwise unable to respond to flow fluctuations from peaking power operations. However, other species and life stages are also impacted by fluctuating flows in less obvious ways. Flow changes can affect the location of suitable habitat, and would necessitate the movement of the individual fish to a different location in the river upon each flow change. If these locations are dispersed or distant from each other, the fish could be displaced from the flow change itself, or need to actively search for the now relocated habitat areas and possibly move substantial distances to find suitable habitat. The consequences of these movements could be vulnerability to predation, energy expenditures to search for and relocate to suitable habitat. Therefore, as noted by the Vermont Department of Fish and Wildlife (VDFW) at the study plan meetings, the Dual Flow Analysis should also be conducted on smaller fish species and life stages. Determination of what species and life stages would be assessed using Dual Flow Analysis should be made in consultation with the Service, the VDFW, the New Hampshire Fish and Game Department, and parties on the Aquatics Working Group.	
FWS	Deliverables: We note that the results of the Dual Flow analysis should be listed in the list of deliverables from the study. In addition, the Service and other parties also recommended including in the analysis, mapping of habitat at various flows to show how the location of suitable habitat changes at various flows. This analysis can be derived from the PHABSIM data.	The study plan has been revised by adding the results of the Dual Flow analysis to the list of deliverables, and to clarify that reports will include appropriate tables and graphics to support the study and analysis.
NHDES	General: Minimum flows are mentioned in several sections of this study. NHDES uses the term protective flows which may mean more than one protective flow at each Project. It should be made clear that the study will address the magnitude, frequency, duration, timing and rate of change of a	We note that the goal of the study is to “assess aquatic resources and habitat…under flow conditions affected by project operations.” This necessarily includes the entire range of flows from the licensed minimum flows (and the higher generated flows used as minimum flow); up to station capacity flows.

Commenter	Comment	Response
	range of flows when determining flows needed to provide suitable habitat for the selected target organisms.	The type of information requested in the comment will be provided from the time series analysis.
NHDES	p. 106. Study Reach, Study Site, and Transect Selection, last bullet. It is stated that preliminary river reaches include Vernon dam downstream approximately 1.5 miles. Please specify how was this distance was determined to be the riverine section downstream of the Vernon dam.	The Introduction section of the RSP document of which this study plan is a part, has been revised to include our rationale as follows: "TransCanada acknowledges that under certain circumstances (extreme low Turners Falls impoundment conditions) the reach below Vernon dam may experience the effect of Vernon discharge to a greater extent than during normal conditions. Therefore, the evaluation of Vernon Project impacts to the section below Vernon dam has been included in the revised study plans. However, TransCanada also proposes that the context of these evaluations include an examination of the frequency, duration and periodicity of such conditions where Vernon dam discharge is a significant and material influencing factor above those associated with FirstLight projects."
NHDES	p. 108, Hydraulic Data Collection, 2nd paragraph, 1st sentence. It is stated that one complete set of depths and velocities will be taken at each transect at the target high flow or the flow level that can be effectively and safely measured. DES recommends that at a minimum another complete set of velocity and depth measurements be taken at or near the low range of agreed upon study flows so that the model can be properly calibrated. Also please specify the accuracy of the velocity meters.	TransCanada respectfully disagrees that an additional set of depths and velocities is needed for model calibration. Bovee (1997) and Bovee et al. (1998) indicate that a single set of velocities at the highest possible flow is preferred. Payne and Bremm (2003) evaluated the effect of multiple velocity calibration sets on the habitat index and concluded that generated habitat index results using a single velocity set deviate only slightly from those incorporating three or more velocity sets. For example, see *Bovee, K.D. 1997. Data collection procedures for the Physical Habitat Simulation System. U.S. Geological Survey, Biological Resources Division, Ft. Collins, CO. 141 pp.; Bovee, K.D., B.L. Lamb, J.M. Bartholow, C.B. Stalnaker, J. Taylor, and J. Henriksen. 1998. Stream habitat analysis using the instream flow incremental methodology. U.S. Geological Survey, Biological Resources Division Information and Technology Report USGS/BRD-1998-0004. viii + 131 pp.; and Payne,*

Commenter	Comment	Response
		T.R., and D.J. Bremm. 2003. The influence of multiple velocity calibration sets on the PHABSIM habitat index. Paper presented to International IFIM User's Workshop, June 1-5, 2003, Ft. Collins, CO. (Document Attached). TransCanada therefore believes that this additional study element is unnecessary and costly and as an additional requirement does not meet ILP Study Criteria 4, 6 and 7. The study plan has been revised to include the accuracy to velocity meters.
NHDES	p.110, Field Data Collection (2-D), 2nd paragraph, 2nd sentence. It is stated that single calibration flow with associated water surface elevations is required for a 2-D site, although additional flows and elevations can assist with model calibration. DES recommends that calibration be based on at least 2 sets of flow and water surface elevations that bracket the range of agreed upon study flows.	We have revised the study plan by adding text stating that additional flow and stage data for 2-D sites will be collected in conjunction with 1D transect data collection.
NHDES	p. 105, Methods. As stated in our study requests 5 and 10, "Data loggers should be deployed in each reach during the study to continuously monitor dissolved oxygen and temperature for comparison to State water quality standards." This should be addressed in the proposed study plan.	TransCanada respectfully disagrees that DO and temperature recording is appropriate or necessary for this study. Currently in the study plan water quality parameters (temperature, DO, pH, and conductivity, and turbidity), water depth and velocity will be recorded for each full transect randomly selected sample segment. We note that Study 6 – Water Quality includes monitoring of DO and temperature as well as other water quality parameters for the purpose of comparison to state water quality standards. Supplemental water quality data will also be provided in several other studies, making it unnecessary to collect such data in this study. TransCanada believes that the requested additional study element on its own does not meet the ILP Study Criteria in the context of what we are proposing. The

Commenter	Comment	Response
		information it will provide as "existing information" does not meet Criterion 4. The methodology we are proposing in the current study plan, absent the additional elements being requested, is generally accepted practice in the scientific community or appropriate and therefore the additional scope is not necessary to meet Criterion 6. The additional scope on its own has a cost and effort that does not warrant inclusion when compared to what we are proposing (the alternative) and therefore does not meet Criterion 7.
NHFG	Delete yellow perch from species to be assessed as they do not require flowing water (per Rod Wentworth). Add sea lamprey (juvenile) and longnose dace to the list.	The study plan has been revised to remove yellow perch and add Longnose dace and juvenile sea lamprey, contingent upon the availability of appropriate HSC.
TNC	Deliverables: We request that TransCanada please make the raw data available so that agency representatives and other interested parties may conduct additional analyses beyond what is done within the scope of this study.	Study related data will be made available to stakeholders upon written request.
VANR	The study plan specifically mentions minimum flows in several locations. We want to be clear that the Agency is concerned about the entire flow regime (magnitude, frequency, duration, timing and rate of change). The objective of the instream flow study is to quantitatively assess the relationship between flow and aquatic habitat for selected target organisms so that the flows needed to provide suitable habitat conditions can be determined. This will involve consideration not only of seasonal conservation flows (formerly known as minimum flows) but of maximum flows and when they occur, how often, and the transition rate. And, the ecological implications of locational shifts in suitable habitat with flow must also be assessed.	We note that the goal of the study is to "assess aquatic resources and habitat…under flow conditions affected by project operations." This necessarily includes the entire range of flows from the licensed minimum flows (and the higher generated flows used as minimum flow); up to station capacity flows. The type of information requested in the comment will be provided from the time series analysis.
VANR	In its scoping of instream flow studies, the Agency typically focuses on riffle reaches. Riffle areas are the most sensitive to flow changes and are also critical to	We acknowledge the comment. While riffle and shallow areas are critical to some life stages, others life stages may utilize deep pools and runs, for example adult

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	the stream's ecological functions. A flow regime that is adequate for riffle areas is likely to satisfy the needs for food production, fish passage, spawning and rearing. Other habitat types (runs, pools) will also be protected since they are less sensitive to flow changes. Fluvial-dependent species and life stages that utilize riffle habitats are then included among the target organisms. The Connecticut River includes a large quantity of impounded, relatively deep habitat with slow moving water. The instream flow studies should focus on organisms that require flowing water conditions and the corresponding habitats.	white sucker and fallfish. The flow study will evaluate all agreed upon species and life stages based on available habitat. This does not preclude the assessment of specific habitat types during the analysis phase of the study. However, the assumption that a flow regime adequate for certain mesohabitats provides suitable flows for others is not certain. A complete flow study must include all available habitats. (This response also addresses the third sentence in the comment below)
VANR	The study plan calls for the inclusion of transects in all mesohabitat types. While we do not object to this, we do have concerns over how the information is used. For example, data from riffles, pools and runs should not be combined for analysis as this masks the effects on the most sensitive areas by pooling them with less affected habitats. We consider riffles to be critical habitat which should be studied using what is sometimes called a "critical reach" approach. Ultimately, a flow regime that provides suitable habitat conditions in riffles must be provided.	The study plan has been revised to remove reference to proportional transect representation. The actual number of transects in each habitat type will all be determined after we present our study site and transect selection document and receive comments from the work group. As noted in the response to the comment above, the assumption that a flow regime adequate for certain mesohabitats provides suitable flows for others is not certain. A complete flow study must include all available habitats.
VANR	As was pointed out by TransCanada's consultants during the study plan review meetings, 2-D hydraulic modeling covers a specific reach of river since it uses a special grid network of data points instead of transects. Such a study reach could include more than one mesohabitat type. The Agency recommends that 2-D study reaches be selected based on the principles described above.	We acknowledge the comment and will take this into consideration during 2-D study site selection. Typically a 2-D study site will include multiple mesohabitat types.
VANR	The species and life stages to be assessed (target organisms) should also focus on those that require or	We note that this will be determined during the HSC consultation, as stated in the study plan.

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	utilize flowing waters, as opposed to generalists such as yellow perch that also live in lake environments. The inclusion of early life stages is particularly important as flow-related habitat bottlenecks often occur at these stages. The details for the selection of target organisms and habitat suitability criteria should be resolved in consultation with the study working group members.	
VANR	The Agency is pleased that TransCanada has included a dual flow analysis in its revised study plan, as part of the assessment of the effects of hydro peaking. The Agency recommends that the study also include graphics (sometimes referred to as habitat maps; not to be confused with the Aquatic Habitat Mapping Study 7) that show categorized PHABSIM cell suitability for selected flows. These graphics [1-D example included in comments] clarify where in the river habitat exists, as well as its quality, and what shifts in location may be occurring. They are helpful in interpreting the dual flow results. The Agency recommends that dual flow results be presented not only as a matrix of values, but also graphically, as shown in the following references. [Milhous, R.T. 1992. Determining the minimum flow below hydro peaking projects. Hydro Review 11(6):67-74; Conners, M.E. and J. Homa Jr. 1992. Presenting dual flow modeling results for flow alternatives analysis. Instream Flow Chronicle II(3):1-3.] Additional details for these analyses should be resolved in consultation with the study working group members.	The study plan has been revised to discuss dual flow analysis that states that the results will be provided in tabular and graphic form. The references cited will be taken into consideration, though more enhanced graphic representations may also be available. The study plan has been revised to clarify that additional details on all aspects of the study will be made in consultation with the working group.

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VANR	The study plan includes a section on "Time Series and Hydrology" that implies that this analysis will be done using habitat duration curves. A habitat time series combines a hydrograph and habitat-flow relationship to produce a graph showing habitat as a function of time. The Agency believes that this type of analysis is more useful than duration curves, especially in hydro peaking situations. However, it is necessary to carefully select the hydrologic data set (year), time step, time of year, target organisms and operating scenarios to be compared. These determinations should be made by the study working group and based on the steady state habitat results.	The study plan has been revised to include habitat time series graphs since they are the basis for developing habitat duration. However, interpretation of time series results generally relies primarily on habitat duration. We will consult with the working group on selection of date for this analysis.

Study 10 – Fish Assemblage Study

Commenter	Comment	Response
CRWC	CRWC supports the call by VFW, NHFG that sampling should take place during day and night time hours and that TC should conduct the sampling with gear as suggested by VFW.	The study plan has been revised to specify evening and nighttime sampling for boat electrofish and experimental gill nets. Trap nets will be deployed during daylight hours and will fish overnight. For safety purposes, any sampling requiring wading with equipment (i.e. back pack or pram electrofish) will be conducted during daylight hours.
FWS	Study Area and Study Sites: We note that TransCanada now proposes to sample downstream of the Vernon Dam (to Stebbins Island). We support the inclusion of this area, as it remains unclear which project's operations exert the most influence over this reach of river.	Study plan revisions reflect stakeholder consultation meetings and discussions held during 3-month comment period.
FWS	Methods: The updated PSP contains a modified study design that addresses some of the comments and concerns raised during the June 6, 2013 study plan meeting. Rather than sample a set number of segments within each general reach of the	Study plan revisions reflect stakeholder consultation meetings and discussions held during 3-month comment period.

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	impoundment (upper, middle, and lower), the geographic area (from the upper limits of the Wilder headpond downstream to Stebbins Island) has been divided into seven strata that generally break down by project and impounded versus free-flowing habitat. TransCanada will sample 12-15 randomly selected 500-meter segments within each stratum, with the exception of the Bellows Falls bypass reach, which, due to its relatively short length, would have five segments.	
FWS	Methods: While TransCanada has incorporated randomization into the study design, the recommendation to conduct replicate sampling has not been adopted. Further, according to the updated PSP, boat electrofishing will be the primary sampling method within each 500-meter segment, unless access within a particular stratum is limited and does not permit boat shocking. It seems likely that a given strata may contain some areas that are conducive to boat electroshocking and some areas that are not. Based on the above, the Service recommends that TransCanada modify the proposed sampling design to stratify by habitat type. The number of sampling stations would be proportional to the amount of that habitat relative to other habitat types. For example, if setback habitat within the defined geographic area represents 15 percent of all habitat, 15 percent of the stations should be in this habitat type (each particular station randomly chosen). To address the replication concern, we recommend that a minimum of three replicates of each habitat-specific type be sampled at each station. These modifications would help address stakeholder concerns and should result in a broader diversity of habitats being sampled effectively.	The study plan has been revised to reflect sample location selection as described in comments by both FWS and TNC. The study area from the upper end of the Wilder impoundment to the downstream portion of Stebbins Island below Vernon will be divided into seven geographic sampling reaches defined by general river morphology and project structures (Wilder impoundment, Wilder DS riverine, Bellows impoundment, Bellows DS riverine, Bellows bypassed reach, Vernon impoundment, Vernon DS riverine). Each geographic region will be divided into sampling strata based on habitat type (e.g., shallow riverine, impoundment, set back, etc.) Habitat types will be based on available substrates and/or mesohabitat types (as identified in Study 7 – Aquatic Habitat Mapping conducted during 2013). A total of 12-15 randomly placed sample 500-meter segments will be located in each of the geographic regions (except in the Bellows bypassed reach and downstream of Vernon where, as physically permitted, three 500-meter segments will be placed due to the limited length of these reaches). As requested by the agencies, these segments will be placed proportional to habitat (i.e., if 50% of geographic reach is impoundment then 50% of

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		randomly placed sample segments will be placed in impoundment habitat). A minimum of three randomly selected sample segments will be placed in each habitat type within each stratum (if available). Within a particular habitat type, a standard gear will be used to avoid bias from varying gear types (e.g., backpack electrofish will be used in all shallow water riffle habitat. We respectfully disagree with the need for replicate sampling of each of the 500-meter segments, based on the study goal and the unreasonably high cost (up to $600,000 or three times higher than the current study plan) this would entail. The primary goal of the study is to document fish species occurrence, distribution, and relative abundance and the study as designed will do that. TransCanada believes that the requested additional study scope on its own does not meet the ILP Study Criteria in the context of what we are proposing. The information it will provide as “existing information” does not meet Criterion 4. The methodology we are proposing in the current study plan, absent the additional elements being requested, is generally accepted practice in the scientific community or appropriate and therefore the additional scope is not necessary to meet Criterion 6. The additional scope on its own has a cost and effort that does not warrant inclusion when compared to what we are proposing (the alternative) and therefore does not meet Criterion 7.
FWS	Methods: It is unclear to the Service why TransCanada has lowered from 50 down to 35 the number of fish of any one species from which individual length and weight data would be collected. Also not specified is how those 35 fish would be chosen. Would it be the first 35 fish, or would a certain number from each	As requested, we have reviewed the FirstLight fish assemblage plan and their proposed method for collecting length and weight data. The study plan has been revised to state: “All fish captured will be identified to species, enumerated,

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	visually assessed length class be measured and weighed? The Service recommends that TransCanada follow the protocol specified in FirstLight's Fish Assemblage study plan: "...all captured fish will be identified to species, classified as adult, juvenile or Young-of-Year (YOY), enumerated, weighed, measured for total length and then released. If large numbers (n>25) of small fish (YOY fish or cyprinids less than 100 mm) are captured they will be grouped by size class, enumerated, and batch-weighed with length measurements only taken from one large and one small representative specimen within each group." In order to be able to adequately assess the size structure and health (i.e., condition factor) of the population, all individual fish of a given species need to be measured and weighed (or, at a minimum, a representative subsample within each length class).	measured (TL), weighed and released. If large numbers (>25) of small fish (e.g. young-of-year during the summer sampling period or cyprinids less than 100 mm) are captured, they will be grouped, enumerated, batch-weighed and representative length samples will be taken from a small and large individual to be representative of the group.
FWS	Methods: The Service supports the reduction in gill net set time, as this addresses concerns raised by the VDFW regarding excessive mortality with this gear type under the initially proposed 24-hour set time. Likewise, we concur with adding in trap nets as a potential gear type.	Study plan revisions reflect stakeholder consultation meetings and discussions held during 3-month comment period
FWS	Analysis: The analysis should be modified according to our proposed changes to the sampling design described above; any summary statistics generated should be by habitat type rather than stratum. We are unsure what TransCanada means by "Effort will be made to incorporate a size class component." At the June 6, 2013 study plan meeting, the Service recommended that the analysis should include a size class breakdown for catch per unit effort per fish species. Given that length and weight will be collected on sampled fish, there should be no reason why that information should not be analyzed and reported; why collect those data if they will not be used? Those data	The study plan has been revised to specify that sampling statistics will be presented by habitat type for each geographic region. The study plan has also been revised to clarify that the intent of the size class comment was to address the request from FWS related to CPUE data. All length-weight data collected during this study will be presented in the report.

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	are what is needed to provide an overall picture of the fish assemblage: what species are in which habitats (during which seasons), how many of each species, what size classes, and in what condition	
FWS	Deliverables: The Service requests that TransCanada provide the raw data, in digital format, to stakeholders, upon request.	The study plan has been revised to state: "All study related data will be made available to the working group upon written request."
NHFG	Coefficient of variation should be reported along with mean relative abundance.	The study plan has been revised to include the reporting of coefficient of variation.
NHFG	[The study plan describes] just boat electrofishing during the day. Night is the preferred time for barge electrofishing, although it could be supplemented with minimal daytime shocking to see if any different species are captured.	The study plan has been revised to specify evening and nighttime sampling for boat electrofish and experimental gill nets. Trap nets will be deployed during daylight hours and will fish overnight. For safety purposes, any sampling requiring wading with equipment (i.e. back pack or pram electrofish) will be conducted during daylight hours.
NHFG	The 24 hour gill net set may cause excessive mortality. Field tests should be used to determine a set time that allows for efficient data collection while minimizing mortality. Perhaps start with 8 hour sets and increase/decrease set time as needed. If heavy mortality becomes an issue in a certain habitat type or time of day/night, then nets should be checked hourly.	The study plan has been revised to indicate that gill net sets will be limited to 2 hours to minimize netting mortality, as discussed at the study plan meeting.
NHFG	Another sampling method to consider is a seine net. A 30' bag seine may work well in shallow coves that cannot be accessed by a shock boat. A large beach seine may also work on open flats where the shock boat often scatters fish before they can be captured.	The study plan has been revised to include the use of seine netting (30' bag seine or large beach seine suggested by NHFG) in shallow coves or flat open areas where electro-shocking or boat access is deemed impractical.
TNC	Project Nexus: On page 116, TransCanada states, "This study…will represent the available habitat within project operational ranges for resident and diadromous fish populations." Because this is not a habitat study, it is not clear how this study will represent available habitat; however, an assessment of available habitat could potentially be made with additional data from the Aquatic Habitat Mapping Study (Study 7) and the	The study plan has been revised by replacing the word "represent" with "sample". The intent of the statement was to inform the reader of our intent to assess the fish assemblage across all habitat types. The study plan has also been revised and the statement in question has been removed.

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	Instream Flow Study (Study 9). Furthermore, it is not clear within the methodology how this study will "allow for the contribution of both factors (project operations and available habitat) to the baseline fisheries conditions to be examined for limiting and non-limiting influences" (p. 117). This claim itself is unclear, as well as the methods for its achievement.	
TNC	Study Area and Study Sites: For the Bellows Falls bypassed reach, we do not recommend changing the size of the sample segment (from 500 m to 100 m) simply because the length of the defined sampling reach is less than that of the other strata, as suggested on page 117. This will cause unnecessary bias in the collected data, such that if there are any differences in assemblage structure at this site, it will be impossible to differentiate actual site effects from sampling bias error. Normalizing the sample by effort may also be ineffective because the relationship between catch and effort is not necessarily linear. Sampling a 100 m segment in a smaller reach implies that a 100 m sample is equivalent to a 500 m sample after normalization. If this were the case, then sampling a 500 m segment would unnecessarily multiply sampling effort at any site. Therefore, either too much sampling is being done at most sites or 100 m is not a sufficient length for a sample. In either case, the methods at present require modification. It is imperative that sampling effort is as equivalent as possible among all sites within all strata. The solution to the problem of strata of greatly disproportionate lengths is either to make all sample segments shorter so that an adequate number of sites can be sampled in each stratum, or simply to sample fewer sites in the shorter reaches, with at least three sample segments in each stratum.	The study plan has been revised to indicate that all sample segments are 500 m in length and a minimum of three segments are sampled in each stratum.

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TNC	Methods: If the issue of collecting a smaller sample in the Bellows Falls bypassed reach is not simply a matter of the length of the stratum, but is an issue associated with gear type, sampling smaller reaches in this one stratum is still not an acceptable solution for reasons similar to those described above. Substantial bias will result if the Bellows Falls bypassed reach is the only stratum that is sampled with pram or backpack electrofishing. Gear bias is the tendency of gear, including different electrofishing methodologies, to select for some species and sizes of fish more than others. If there are any differences within the Bellows Falls bypassed reach data set compared to other sites, it will be impossible to differentiate gear bias error from any actual site effects. In order to accurately characterize the fish assemblage of the project area, sampling methods must be consistent throughout the entire study area. Because different gear types have different efficiencies in various habitat types, it may be effective to stratify sampling by habitat type. If backpack/pram electrofishing is the only effective method for sampling the Bellows Falls bypassed reach, then this is a valuable method that should be used in other sections of the study area (e.g., in shallow riffles and runs). The Aquatic Habitat Mapping Study (Study 7) could potentially assist in identifying different habitat types. We suggest that once Study 7 is completed, the results should be used to inform site and/or gear selection for this study. We recommend that sites be chosen randomly, but proportionally by habitat type. At each site, at least three replicates of each habitat-specific gear type should be sampled. This prevents bias from anomalous samples, allows for site-level statistical evaluation, and is standard scientific field design (Eberhardt and Thomas 1991, Krebs	The study plan has been revised to reflect sample location selection as described in comments by both FWS and TNC. The project area from the upper end of the Wilder impoundment to the downstream portion of Stebbins Island below Vernon will be divided into seven geographic sampling reaches defined by general river morphology and project structures (Wilder impoundment, Wilder DS riverine, Bellows impoundment, Bellows DS riverine, Bellows bypassed reach, Vernon impoundment, Vernon DS riverine). Each geographic region will be divided into sampling strata based on habitat type (e.g., shallow riverine, impoundment, set back, etc.) Habitat types will be based on available substrates and/or mesohabitat types (as identified in Study 7 – Aquatic Habitat Mapping conducted during 2013). A total of 12-15 randomly placed sample segments will be located in each of the geographic regions (except Bellows bypassed reach and downstream of Vernon where 3 will be placed). As requested by the agencies, these segments will be placed proportional to habitat (i.e., if 50% of geographic reach is impoundment then 50% of randomly placed sample segments will be placed in impoundment habitat). A minimum of three randomly selected sample segments will be placed in each habitat type within each stratum (if available). Within a particular habitat type, a standard gear will be used to avoid bias from varying gear types (e.g., backpack electrofish will be used in all shallow water riffle habitat. We respectfully disagree with the need for replicate sampling of each of the 500-meter segments, based on the study goal and the unreasonably high cost (up to $600,000 or three times higher than the current study plan) this would entail. The primary goal of the

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	1998). Alternately, one sample each of three different habitat-specific gear types could be considered independent replicates. This kind of robust, stratified random sampling design is especially important if the collected data are to be "examined for limiting and non-limiting influences," as suggested in the Nexus (p. 117). Without replicates it is difficult if not impossible to draw conclusions from the data; this is basic statistical and scientific methodology (Eberhardt and Thomas 1991, Krebs 1998).	study is to document fish species occurrence, distribution, and relative abundance and the study as designed will do that. TransCanada believes that the requested additional study scope on its own does not meet the ILP Study Criteria if one considers what we are proposing and the information it will provide as "existing information" it doesn't meet Criterion 4. The methodology we are proposing in the current study plan, absent the additional elements being requested, is generally accepted practice in the scientific community or appropriate and therefore the additional scope is not necessary to meet Criterion 6. The additional scope or element or request on its own has a cost and effort that does not warrant inclusion when compared to what we are proposing (the alternative) and therefore does not meet Criterion 7.
TNC	Analysis: On page 121, TransCanada states that "Summary statistics will be calculated by stratum and sampling technique…" If summary statistics are to be calculated by sampling technique, then the premise is that values of different strata and sampling techniques can be compared. In order for this to be true, the collection of samples within each stratum and by each sampling technique needs to follow a similar sampling design (e.g., stratified random, as described briefly above). Otherwise, it is not possible to compare strata or sampling techniques and draw inference concerning differences or similarities among them. Sampling methodologies should be used consistently, and never simply as a substitution in areas where habitat makes sampling difficult. Catches among gear types can only be compared if they have been sampled with the same basic design, and if they are intended to sample the same habitat.	The study plan has been revised to reflect the random selection of sample locations in a manner proportional to habitat type and will use consistent sampling methodologies as dictated by the habitat in the sample area.
TNC	Deliverables: We request that TransCanada please	The study plan has been revised to state: "All study

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	make the raw data from this study available in digital format so that agency representatives and other interested parties may conduct additional analyses beyond what is done within the scope of this study.	related data will be made available to stakeholders the working group upon written request."
TNC	Schedule: Because the development of field study design is critical to the ability to use study results, we strongly support and value the included allowance provided in the schedule (p. 122) to share the sampling locations with the aquatics working group for consultation and approval.	Study plan revisions reflect stakeholder consultation meetings and discussions held during the 3-month comment period.
VANR	The proposed methods include electrofishing (boat, pram, and backpack) and gill netting with experimental nets…The Agency recommends that sampling methodologies include a multi-gear approach and are consistent with the American Fisheries Society's national standards [Bonar, S. A., W. A. Hubert, and D. W. Willis, editors. 2009. Standard methods for sampling North American freshwater fishes. American Fisheries Society, Bethesda, Maryland. 335 pages.].	We have reviewed the suggested fisheries sampling methods for use in riverine systems presented in Bonar et al. (2009). Bonar et al. (2009) recommends that for standardized sampling efforts, the gear types that capture the greatest numbers and broadest length ranges for the fish assemblages of interest be employed. The study plan has been revised to incorporate electrofishing (boat, pram and backpack), experimental gill nets, and trap nets. In addition, trawl data collected during trawl sampling in Study 12 (Tessellated Darter Survey) will be incorporated. This selection of sampling gears will representatively sample the diverse fish communities located in the Project areas.
VANR	The licensee should also consider employing a benthic trawl (as will be used in Study 12), in order to target deep water benthic habitat. The Agency recommends that the licensee employ a stratified random sample design to capture the spatio-temporal variability. The sampling sites should be stratified by habitat type, depth of water, day or night (or time of day), as well as distance from the dam, and season (spring, summer, fall).	The study plan has been revised to indicate that experimental gill net sets will be conducted to sample deep water habitat and will be deployed in a manner to sample above the bottom substrate. Benthic trawl data collected during the summer as part of Study 12 (Tessellated Darter Survey) will be incorporated into findings on the general fish assemblage of the Project areas. A total of 12-15 randomly placed sample 500-meter segments will be located in each of the geographic

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		regions (except in the Bellows bypassed reach and downstream of Vernon where, as physically permitted, three 500-meter segments will be placed due to the limited length of these reaches). Segments will be placed proportional to habitat (i.e., if 50% of geographic reach is impoundment then 50% of randomly placed sample segments will be placed in impoundment habitat). A minimum of three randomly selected sample segments will be placed in each habitat type within each stratum (if available). Within a particular habitat type, a standard gear will be used to avoid bias from varying gear types (e.g., backpack electrofish will be used in all shallow water riffle habitat.
VANR	The licensee proposes that for experimental gill nets; “Nets will be set and allowed to fish for a 24-hour period prior to pulling.” The Agency recommends that the nets soak for no more than two hours per set, as soaking for a 24-hr period will cause significant mortality.	The study plan has been revised to limit gill net sets to 2 hours to minimize netting mortality, as discussed at the study plan meeting.
VANR	The licensee proposes to collect water quality data at the time of sampling. Parameters include temperature, DO, pH, and conductivity. The Agency recommends that turbidity also be included as a parameter because high turbidity will affect the visibility (and hence catch rate) during electrofishing. Studies have also shown that high turbidity reduces the ability of fishes to see the trawl net during benthic trawling. This may also affect catch rates.	The study plan has been revised to include collection of turbidity data.
VANR	The Agency agrees with the licensee’s proposed study plan revisions as described [in the summary table of meeting comments and responses].	Study plan revisions reflect stakeholder consultation meetings and discussions held during the 3-month comment period.

Study 11 – American Eel Survey

Commenter	Comment	Response

Commenter	Comment	Response
CRWC	[This comment was a combined comment for studies 11, 18, 29 and 20]. If the sampling numbers are sufficient to generate useful data using eel pots, then the fieldwork should rely on eel pots as much as possible to reduce harm to eels during sampling. One note is that there is a higher level of damage to eels captured with electro shocking than there are with eel pots. (James B. Reynolds and F. Michael Holliman, 2003). In order to get the fullest picture of the presence of American eels in the CT River watershed, eel sampling should take place at several migration barrier locations on the tributaries even though they are outside the immediate influence of the project operations. Examples of these locations are the falls at Drewsville, NH on the Cold River; the face of the dam in Springfield, VT in the Black River; below the falls at Brockway Mills, VT on the Williams River and at the base of Twin Falls on the Saxtons River.	Given the anticipated low densities of eels in the impoundments coupled with the large search area, boat electrofishing provides the most effective way to increase the likelihood of encountering individuals. However, the study plan has been revised to incorporate both eel pots and electrofishing into the impoundment/tributary surveys. Eel pots are most effective in areas of know high densities. The study plan has been revised to include an additional tributary sampling component but still within the limits of project influenced areas. We will add 24 randomly selected tributary locations within the three Projects (roughly 20% of the ~120 perennial tributary streams). Those locations will be sampled by electrofishing as far upstream as the extent of project affects. We will consult with the working group prior to a final sampling design to ensure that tributaries of highest interest are selected with the remaining number selected randomly.
FWS	Methods: Electrofishing Surveys TransCanada has modified the study design from sampling a defined number of transects upstream of each dam to a specified number of segments within a given strata. While the overall number of sampling events will increase, because each segment is 500 meters (versus the original proposed 1,000 meters), the net result is that less habitat will be sampled. For example, at Wilder, originally 17.4 miles of river were to have been sampled, whereas only 11.1 miles will be sampled under the updated PSP. While this decreased effort is of concern, the increased number of sampling events and randomized design may result in an increased number of habitats being surveyed; therefore, the Service does not object to this change. Eel Traps In response to comments raised during the	Study plan revisions reflect stakeholder consultation meetings and discussions held during the 3-month comment period.

Commenter	Comment	Response
	May 23, 2013 study plan meeting regarding the number of eel traps initially proposed, TransCanada has changed the survey methodology similar to the electrofishing survey: the geographic area will be divided into strata of 500-meter segments and eel traps will be placed in a specified number of randomly selected segments within each strata. The net result is an increase in the number of eel traps deployed. The Service supports this change.	
NHFG	Need to detail marking eels captured in eel pots as they did for those captured by electrofishing.	The study plan has been revised to include marking of eels captured during eel pot sampling.
NHFG	The goal of the study is to collect baseline information on the eels in the mainstem, within project boundaries, so that future trends can be monitored. The actual abundance of eels potentially impacted by the projects could only be assessed by a watershed-wide survey, since eels may potentially inhabit all of the tributaries and lakes upstream of the projects. The extent of this potential habitat, which will not be surveyed, should be considered when evaluating the need for downstream eel passage.	TransCanada considers the comment requesting a watershed survey to be an expanded study request. TransCanada respectfully disagrees that this request meets ILP Study Criterion 5 in that such information would not provide results or inform the development of license requirements. As currently proposed, the sampling within project affected areas including the affected areas in the vicinity of tributaries known for the likely presence of American eels, will reasonably provide baseline information on eels within the mainstem and within project boundaries and could serve as the basis for future monitoring. Therefore, as an additional scope of work and cost, TransCanada does not believe this adequately meets ILP Study Criterion 7.
VANR	The Agency requested an eel survey be conducted in the mainstem river and tributaries upstream from the three projects. In general, a combination of electroshocking (backpack in wadeable rivers and boat-mounted in larger rivers and lakes) and eel pots should be used to collect eels and determine catch rates.	The study plan has been revised to include sampling for eels within both the mainstem river as well as tributary habitat upstream as far as project affects occur. The sampling design for mainstem impounded and riverine areas will remain as described in the revised study plan (a total of 37 shoreline segments randomly selected in the Wilder impoundment, 15 in the riverine section downstream of Wilder, 22 in the Bellows Falls impoundment, 5 in the riverine section

Commenter	Comment	Response
		downstream of Bellows Falls and 22 within the Vernon impoundment). The study plan has been revised to add a tributary sampling component but still within the limits of project influenced areas. The revised study plan will add 24 randomly selected tributary locations but the three projects (roughly 20% of the ~120 perennial tributary streams). Those locations will be sampled by electrofishing as far upstream as the extent of Project affects. We will consult with the stakeholders prior to a final sampling design to ensure that tributaries of highest interest are selected with the remaining number selected randomly.
VANR	Sampled habitat should include: the mainstem Connecticut River from upstream of Vernon Dam to below the Dodge Falls project located in Ryegate, VT; tributaries to the Connecticut within that stretch where eels have been collected previously; and lakes and ponds (such as, but not limited to, Spofford Lake and Lake Morey), where eels have been collected previously. Sampling should occur during the summer (July through September)…FERC guidelines on developing study criteria for the ILP process indicates that a FERC project boundary is not appropriate in limiting the geographic scope of studies and the geographic scope should be determined by the effects of the project on the resource in question…Eels are known to occur within lakes, ponds and tributaries located above and outside the project-affected areas. In order for the Agency to assess the need to provide downstream fish passage for eels the relative abundance of the number of eels above each project is needed. As currently designed, the study will yield an underestimate of the eel population and will not be sufficient for assessing the need for downstream passage. Therefore, downstream passage prescriptions	The study plan has been revised to add a tributary sampling component to this study and will randomly select 24 tributary locations upstream from the three projects (roughly 20% of the ~120 perennial tributary streams). Those locations will be sampled by electrofishing as far upstream as the extent of project affects. We will consult with the working group prior to a final sampling design to ensure that tributaries of highest interest are selected with the remaining number selected randomly. TransCanada considers the comment requesting a watershed survey to be an expanded study request. TransCanada respectfully disagrees that this request meets ILP Study Criterion 5 in that such information would not provide results or inform the development of license requirements. As currently proposed, the sampling within project affected areas including the affected areas in the vicinity of tributaries known for the likely presence of American eels, will reasonably provide baseline information on eels within the mainstem and within

Commenter	Comment	Response
	should not be based on these results. The Agency recommends that a watershed survey should be done to provide data for passage prescriptions because all eels will have to pass through the projects in order to migrate to the ocean. The Agency does not agree with the licensee's response to limit the study scope to the mainstem.	project boundaries and could serve as the basis for future monitoring. Therefore, as an additional scope of work and cost, TransCanada does not believe this adequately meets ILP Study Criterion 7.
VANR	The Agency would be willing to collaborate with the licensee to obtain more representative estimates. For example, if the licensee were to tag yellow eels and monitor within project affected areas, the Agency would be willing to take over and monitor/and or sample throughout the tributaries and ponds. These data would provide more robust results.	The objectives of this study are to characterize the distribution and relative abundance of eels within the impoundments and riverine sections upstream of each Project. At this time we intend to rely on a combination of electrofishing and eel pot sampling at randomly selected stations spread across the entire study reach to achieve those objectives.

Study 12 – Tessellated Darter Survey

Commenter	Response	Commenter
FWS	Methods: The updated PSP proposes use of an electrified benthic trawl to effectively sample darters…TransCanada has provided some explanation of how they believe that neither the trawl itself nor the electric current that DWM could be exposed to are likely to cause adverse impacts…We cannot determine whether the proposed use of a modified trawl would avoid adverse effects to adult or juvenile DWM without supporting documentation or evidence that the modifications have been successfully implemented elsewhere…. Therefore, we recommend further coordination with the Service in the refinement of the study design in order to develop a study plan that will provide sufficient data on tessellated darters and also fulfill Endangered Species Act (ESA) requirements.	TransCanada has consulted with FWS and FERC, and as a result, has revised the study plan to address concerns over impact to Dwarf wedgemussels due to use of electrified benthic trawl. The study plan has been revised by eliminating the electrified benthic trawl method and replacing it with snorkel/SCUBA visual surveys in reservoirs sections of the study area. We believe, based on the consultation on Aug. 9, 2013, that this approach addresses FWS concerns.
FWS	Methods: Because the tessellated darter survey most	To eliminate the need to initiate Section 7 ESA

Commenter	Response	Commenter
	likely will occur within occupied DWM habitat, it is likely that there will be effects on individual mussels or glochidia. The Commission will need to initiate consultation and provide an effects determination to the Service and request our review and concurrence (under section 7 of the ESA) once a Final Study Plan has been developed.	consultation, TransCanada has consulted with FWS and FERC, and as a result, the study plan has been revised by eliminating the electrified benthic trawl method and replacing it with snorkel/SCUBA visual surveys in reservoirs sections of the study area. We believe, based on the consultation on Aug. 9, 2013, that this approach addresses FWS concerns.
NHFG	There is some concern about potential fish mortality due to use of the electrified trawl.	The study plan has been revised by eliminating the electrified benthic trawl method and replacing it with snorkel/SCUBA visual surveys in reservoirs sections of the study area.
TNC	Study Area and Study Sites: We recommend adding one more sampling segment to the reach below Vernon. Doing so will allow for greater statistical inference. If adding one more site is unacceptable in terms of study costs, we suggest re-evaluating the distribution of effort elsewhere, sampling proportionally by length of the reach, but with a minimum of three sites in each stratum. Alternately, the size of the individual samples could be changed in order to keep costs equivalent.	The study plan has been revised to extend the sampling segment downstream of Vernon dam to approximately 1.5 miles to the downstream extent of Stebbins Island, in keeping with other study plans and based on the RSP introduction section discussing the relationship between TransCanada and FirstLight projects. We have adjusted the distribution of samples such that each geographic reach contains a minimum of three sites.
TNC	Methods: The recommendations provided for the Fish Assemblage Study (Study 10) with regard to sampling design apply to this study as well. Sampling methodologies should be used consistently, and never simply as a substitution in areas where habitat makes sampling difficult. Sampling methods cannot be determined on a case-by-case basis as implied (p. 134). This causes bias in the collected data, and makes it difficult if not impossible to distinguish differences in population size and structure at a site from error due to gear bias. Therefore, we strongly suggest that methods be used consistently across habitat types. The Aquatic Habitat Mapping Study (Study 7) should be useful for determining various habitat types and the gear that will be required to sample them. If only one method is being used, sites	The study plan has been revised by eliminating the electrified benthic trawl method and replacing it with snorkel/SCUBA visual surveys in reservoirs sections of the study area. The study area from the upper end of the Wilder impoundment to the downstream portion of Stebbins Island below Vernon will be divided into six geographic sampling reaches defined by general river morphology and project structures (Wilder impoundment, Wilder DS riverine, Bellows impoundment, Bellows DS riverine, Vernon impoundment, Vernon DS riverine). Each geographic region will be divided into sampling strata based on habitat type (e.g., shallow riverine, impoundment, set back, etc.) Habitat types will be based on available substrates and/or mesohabitat

Commenter	Response	Commenter
	should be randomly selected from those sites that may be effectively sampled by that particular gear type. Ideally, replicate samples should be taken at a site (e.g., three 2-minute tows per 500 m reach instead of one 5-minute tow). This prevents bias from anomalous samples, allows for site-level statistical evaluation, and is standard scientific field design (Eberhardt and Thomas 1991, Krebs 1998). Alternately, three samples of different sampling gear types could achieve a similar result.	types (as identified in Study 7 conducted during 2013). As was proposed in the revised study plan, a total of 14 segments will be randomly selected in the Wilder impoundment, 8 in the Bellows Falls impoundment, 8 within the Vernon impoundment, 9 in the Wilder downstream riverine corridor, 4 in the Bellows Falls downstream riverine corridor, and 2 within the Vernon tailrace. As requested, these segments will be placed proportional to habitat (i.e., if 50% of geographic reach is impoundment then 50% of randomly placed sample segments will be placed in impoundment habitat). Within a particular habitat type, a standard gear will be used to avoid bias from varying gear types (e.g., in all deep water impoundment habitats, three randomly selected areas within each of the segments will have five fixed center plots distributed across the channel that will be assessed using snorkel/SCUBA visual assessment methods).
TNC	Methods: We advise extreme caution when using information on dwarf wedgemussel (DWM) distribution to inform sample station placement. Details in the methods suggested that sites would be placed both to avoid DWM (p. 135) and to ensure that sampling occurs within the DWM distribution (p. 133-134, "Study Area and Study Sites"). However, care should be taken that this directed placement does not bias results toward artificially positive association (if adding sites near DWM populations) or artificially negative association (by avoiding sites near DWM populations). We recommend that a gear type is selected that is acceptable to use in areas where DWM are present, and that this gear type is used consistently across the entire study area. To ensure that samples are collected in areas where DWM are present, DWM distribution data can be used to define the spatial extent of sampling strata. However, samples must still be randomly selected within strata	Sampling methods will be standardized for a unique habitat type. However, the number of differing habitat types over the large study area will require the use of more than one method. The study plan has been revised to rely on randomly placed sampling locations within each geographic sampling reach with sampling stratum defined by habitat type (and not the presence or absence of DWM). This approach should allow us to achieve the primary study goal which is characterization of the distribution and relative abundance of tessellated darter within project-affected areas.

Commenter	Response	Commenter
	to prevent bias in the data, which would severely limit the ability to draw conclusions from the results. The objective of this study is to characterize the distribution and relative abundance of tessellated darter (p. 130), with an aim to relate this distribution and abundance to that of DWM. Whereas it is not necessary to sample exactly where DWM occur, it is imperative to ensure the spatial design of the sampling protocol is sufficient to meet this objective.	
TNC	Methods: Because the development of field study design is critical to the ability to use study results, we strongly support and value the included allowance provided to consult with the aquatics working group "to determine the most appropriate sampling gears and placement of sampling locations to both minimize potential disturbance of DWM while maintaining a defensible and scientifically sound sampling procedure."	Study plan revisions reflect stakeholder consultation meetings and discussions held during the 3-month comment period
TNC	Deliverables: We request that TransCanada please make the raw data from this study available in digital format so that agency representatives and other interested parties may conduct additional analyses beyond what is done within the scope of this study.	The study plan has been revised to state: "All study related data will be made available to stakeholders upon written request."
VANR	The Agency recommends that trawling methods be consistent with section 5.3.3 from the following reference. Bonar, S. A., W. A. Hubert, and D. W. Willis, editors. 2009. Standard methods for sampling North American freshwater fishes. American Fisheries Society, Bethesda, Maryland. 335 pages.	The study plan has been revised to indicate that trawling techniques will generally follow methodology presented in Bonar et al. (2009).
VANR	The Agency also recommends that turbidity measurements be taken at the time of sampling because studies have shown that as turbidity increases the ability for fishes to see the net decreases which could affect catch rates.	The study plan has been revised to include collection of turbidity data.

Study 13 – Tributary and Backwater Fish Access and Habitats Study

Commenter	Comment	Response
FWS	Methods: TransCanada has modified the updated PSP to include consultation with the Aquatic Working Group with respect to evaluating the preliminary data and selecting sites for further, intensive study. The Service supports this change. However, as the plan now reads, it is unclear to us what screening metrics will be used to identify those "shallow inlets and shoal areas with the greatest chance of impeding fish movement." Will it be the 1-foot depth criterion cited later in the section, or some other measure? If it is the former, it would seem unnecessary to meet with the working group, as there would be no need to further reduce the number of sites to monitor in 2014 (i.e., all of the sites meeting that criterion should be evaluated).	The study plan has been revised to clarify that the initial criterion will be the 1-ft depth or less, and depending upon the total number of sites identified in Study 7 – Aquatic Habitat Mapping in 2013, we expect that a subset of those sites will be evaluated for this study in 2014. We will consult with the working group following the 2013 field work for Study 7 to determine the location and number of sites to study further in 2014. Not all sites with 1 ft of depth will impede fish passage, and other criteria including length of the shallow water zone, available cover, or sites with depths less than 6 inches will also need to be evaluated for this study based on the 2013 Study 7 data.
FWS	Methods: The protocol for monitoring the selected sites is confusing. Selected sites would have water level recorders installed and operated for one year. Water quality data would only be collected at those sites if access to the main river is found to be impeded. However, the reason those sites were selected is because they had water depths less than 1 foot; therefore, water quality data should be collected at all of the selected sites.	The study plan has been revised to indicate that water quality data will be collected at all of the sites ultimately selected for this study, with those sites based on the 2013 Study 7 results and consultation with the working group.
FWS	Analysis: The updated PSP is not clear on how the collected data will be presented. The Service recommends that one of the products be bathymetric maps of all selected sites, showing the location where the recorder was installed. Not only will it be important to know how depth changes seasonally and with project operations, but also how wide that minimum depth is as it relates to zone of passage.	The study plan has been revised to specify that we will present bathymetry maps of the flow-impeded sections of selected backwater and tributary sites and showing where the depth recorder was installed.

Commenter	Comment	Response
NHFG	Will perched culvert locations be documented? Tributary access should be examined year round as fish should be able move in and out of these backwater areas as needed.	The study plan has been revised to specify that perched culverts within the project boundaries will be examined, with a primary focus in this study on those in the backwater areas. Culverts in tributaries and related access issues will also be examined during other parts of the year in the associated fish spawning and assemblage studies.
NHFG	It is stated in study plan that “Additional water quality data will be collected in these areas (temperature, DO, pH, conductivity, and turbidity) if it is found that access to the main river is impeded.” Water quality should be collected in these backwaters regardless of fish access. While fish may have access to a backwater, water quality may not be hospitable for fish if there is not a good exchange of water between the backwater and the mainstem.	We are not opposed to randomly selecting a subset of the backwater areas for additional water quality data collection; however, we are opposed to collecting such data at all of them if there is adequate water exchange. The study plan has been revised to include water quality sampling at a random subset of the 23 backwater areas, selected based on results of Study 7 in 2013 and in consultation with the working group on site selection for this study.
NHFG	It is not clear how tributaries will be selected in the second year of study. It will be important to let the fish data inform the relative value of a tributary or cove, as opposed to the habitat data alone.	The study plan has been revised to clarify that the initial criterion will be the 1-ft depth or less, and depending upon the total number of sites identified in Study 7 – Aquatic Habitat Mapping in 2013, we expect that a subset of those sites will be evaluated for this study in 2014. We will consult with the working group following the 2013 field work for Study 7 to determine the location and number of sites to study further in 2014. Not all sites with 1 ft of depth will impede fish passage, and other criteria including length of the shallow water zone, available cover, or sites with depths less than 6 inches will also need to be evaluated for this study based on the 2013 Study 7 results.
VANR	The licensee is proposing that during the first study year (2014), water level recorders (estimated 30 units total) will be placed in selected backwaters and tributary areas and will operate for an entire year to collect hourly depth changes and water temperature. Additional water quality data will only be collected in these areas (temperature, DO, pH, conductivity, and	We are not opposed to randomly selecting a subset of the backwater areas for additional water quality data collection; however, we are opposed to collecting such data at all of them if there is adequate water exchange. The study plan has been revised to include water quality sampling at a random subset of the 23 backwater areas, selected based on results of Study 7

Commenter	Comment	Response
	turbidity) if it is found that access to the main river is impeded. However, the Agency requests that water quality be monitored at a randomly selected subset of the 22 setback areas, because even if there is connectivity water quality may not be maintained.	in 2013 and in consultation with the working group on site selection for this study.
VANR	The Agency requests that methods include a comparison of water quality between the mainstem and setbacks/tributary areas to establish relative differences between the two habitat types.	The study plan has been revised to include this data comparison in a random subset of backwater areas that will have water quality data collected. This subset will be selected based on the 2013 Study 7 results and consultation with the working group.
VANR	The Agency requests that a one-foot depth or less at the mouth of tributary or setback be the trigger for concerns relative to fish movement (i.e., depth barrier).	The study plan has been revised to clarify that the initial criterion will be the 1-ft depth or less, and depending upon the total number of sites identified in Study 7 – Aquatic Habitat Mapping in 2013, we expect that a subset of those sites will be evaluated for this study in 2014. We will consult with the working group following the 2013 field work for Study 7 to determine the location and number of sites to study further in 2014. Not all sites with 1 ft of depth will impede fish passage, and other criteria including length of the shallow water zone, available cover, or sites with depths less than 6 inches will also need to be evaluated for this study based on the 2013 Study 7 data.

Study 14 – Resident Fish Spawning in Impoundments Study

Commenter	Comment	Response
CRWC	The fish spawning study should record where newly deposited sediment has covered suitable spawning habitat. The study should make an assessment of whether the deposition is from project operations or if other flows were a factor.	The habitat, bathymetry and erosion studies (studies 2, 3 and 7) will provide data on sediment deposition and where it is located in the study area. It is beyond the scope of this study to attempt to assess the causes of deposition.

Commenter	Comment	Response
FWS	Methods: One element raised at the May 23, 2013 study plan meeting that does not appear to have been incorporated into the updated PSP is the need for TransCanada to consult with the state fisheries agencies regarding specific locations to target for monitoring. State fisheries biologists have substantial on-the-ground experience and knowledge that should be used to assist in identifying potential spawning sites.	The study plan has been revised to include consultation with state fisheries agencies to target monitoring locations.
FWS	Methods: The Service recommends adding the eastern silvery minnow as a target species that depends on backwater coves for spawning.	TransCanada respectfully disagrees that this fish should be added to the target fish species list. This fish would be very difficult to locate and directly observe spawning because it does not build a nest and lays its small 1mm eggs on ooze in backwater areas, in depths of 2 to 6 inches of water. In backwater coves that we will be subsampling for impacts to other target fish (pickerel, yellow perch etc.), if it is found by sampling gear, we can use the depth data collected by the HOBO in that particular location to determine if project operations may impact this fish species spawning. Because of the difficulty in observing this small fish during spawning activity, we cannot commit to observing this fish spawning, or determining the outcome of the eggs and larvae for this fish species. For the reasons stated above, TransCanada does not believe that this request (as a stand-alone study plan element that would require extremely difficult and likely inaccurate assessments) could be made by other methods currently proposed, and ultimately the request does not meet ILP Study Criteria 6 and 7.
NHFG	The study focuses on spawning habitat where water depths at the lowest operation range are wetted to a depth less than one foot. This approach discounts areas that are wetted at the highest operation range and then subsequently dewatered. Yellow perch, for example, spawn in early spring among the branches of	TransCanada respectfully disagrees. The plan for early spring spawners, such as yellow perch, walleye, white sucker and pickerel will study whether the eggs are impacted by project sub-daily operations at a subsample of spawning sites. This effort includes fish that may spawn at the higher operational range and

Commenter	Comment	Response
	trees that fall into the water along the shoreline. These areas may be in relatively deep water, yet the eggs may still be exposed as the impoundment is drawn down. Fish behavior and spawning habitat type should take precedence over depth when choosing areas to monitor for the impacts of water level fluctuation.	potentially have their eggs dewatered due to operations. We will consult with the state fishery agencies to target monitoring locations.
NHFG	The actual impact of water level fluctuation goes beyond direct impacts to fish eggs and spawning behavior under current conditions. Water level fluctuation has a cumulative impact on fish habitat over time by preventing the establishment of aquatic plant communities and altering sediment deposition. The predicted distribution of aquatic vegetation and various substrate types in the impoundment under a more natural flow regime should be mapped to assess the long term effects of water level fluctuation on fish spawning habitat.	We concur that the presence or absence of aquatic plant communities and sediment can impact fish spawning. However, the goal of this study is to assess spawning under the range of current project operations. Within the scope of this study we will not be able to predict future distributions of plant communities or sediment, nor map their locations under a generalized “more natural flow regime” which has not been defined.
NHFG	It is not clear how impacts to spawning will be adequately assessed beyond the dewatering of known nest sites. Inaccessibility of spawning habitat and nest abandonment are important impacts that will be difficult to document without extensive field observation.	Nest abandonment can occur when water depths get too shallow or they are dewatered and that will be investigated at a subsample of spawning sites that are located during extensive field surveys. The bathymetry and habitat survey (study 7) will provide data on habitat that is not available for spawning fish due to project operations. The instream flow study (study 9) and HEC-RAS modeling efforts will also provide data on habitat that is impacted by fluctuating water levels during various flows.
NHFG	The eastern silvery minnow should be included in this study as a species that depends on backwater coves for spawning.	TransCanada respectfully disagrees that this fish should be added to the target fish species list. This fish would be very difficult to locate and directly observe spawning because it does not build a nest and lays its small 1mm eggs on ooze in backwater areas, in depths of 2 to 6 inches of water. In backwater coves that we will be subsampling for impacts to other target fish (pickerel, yellow perch etc.), if it is found by sampling gear, we can use the depth data collected by the

Commenter	Comment	Response
		HOBO in that particular location to determine if project operations may impact this fish species spawning. Because of the difficulty in observing this small fish during spawning activity, we cannot commit to observing this fish spawning, or determining the outcome of the eggs and larvae for this fish species. For the reasons stated above, TransCanada does not believe that this request (as a stand-alone study plan element that would require extremely difficult and likely inaccurate assessments) could be made by other methods currently proposed, and ultimately the request does not meet ILP Study Criteria 6 and 7.
VANR	The proposed study plan will be conducted [by] field surveys to assess potential effects of impoundment fluctuation on nest abandonment, spawning fish displacement, and egg dewatering. However, it is well known that the widened impoundments due to the dams replace riverine (lotic) habitats with a lake-like (lentic) environment. These impoundments serve as repositories for silt and sediments that cover natural gravel substrate that serve as spawning and habitats. Therefore, the Agency is requesting that the study investigate sedimentation, or the amount of fines within a nest (in addition to nest abandonment, spawning fish displacement, and egg dewatering) as a potential negative impact due to the project's impoundments and operations.	The study plan has been revised to include subsampling of fish nests after eggs hatch and larvae disperse, to assess the amount of silt and sediment, as well as scour in the nests. A subsample of abandoned nests identified during the study will also be included in this assessment.

Study 15 – Resident Fish Spawning in Riverine Sections Study

Commenter	Comment	Response
CRWC	The fish spawning study should record where newly deposited sediment has covered suitable spawning habitat.	The habitat, bathymetry and erosion studies (studies 2, 3 and 7) will provide data on sediment deposition and where it is located in the study area. It is beyond the scope of this study to attempt to assess the causes

Commenter	Comment	Response
	The study should make an assessment of whether the deposition is from project operations or if other flows were a factor.	of deposition.
FWS	Study Goals and Objectives: The Service supports the inclusion of the reach downstream of Vernon Dam as a location to assess impacts of the project on spawning habitat and spawning activity by resident fish in riverine habitat.	Study plan revisions reflect stakeholder consultation meetings and discussions held during the 3-month comment period.
FWS	Methods: As noted under our comments on Study 14, the Service recommends that the updated PSP include consultation with the state fisheries agencies regarding specific locations to target for monitoring. State fisheries biologists have substantial on-the-ground experience and knowledge that should be used to assist in identifying potential spawning sites.	The study plan has been revised to include consultation with state fisheries agencies to target monitoring locations.
FWS	Methods: In addition to the physical and chemical data TransCanada proposes to collect at identified spawning locations, the Service recommends assessing for effects of scouring and sedimentation, as these can impact egg survival.	The study plan has been revised to include subsampling of fish nests after eggs hatch and larvae disperse, to assess the amount of silt and sediment, as well as scour in the nests. A subsample of abandoned nests identified during the study will also be included in this assessment.
NHFG	Examining project effects of scouring and sedimentation as it impacts nests would be prudent as scouring and sedimentation can impact egg survival.	The study plan has been revised to include subsampling of fish nests after eggs hatch and larvae disperse, to assess the amount of silt and sediment, as well as scour in the nests. A subsample of abandoned nests identified during the study will also be included in this assessment.

Commenter	Comment	Response
NHFG	The longnose dace is a fluvial specialist that should be added to the list of target species.	TransCanada respectfully disagrees that this fish should be added to the target species list. This fish would be very difficult to observe spawning due to its small size and because it typically spawns in swift flowing streams in riffle areas. The eggs are small, transparent and adhesive and would be very hard to find in fast water. In addition, this species does not build nests. This species may also spawn over several months (beginning in May-Aug), making the field effort to locate this as a target fish prohibitively expense and prolonged. For the reasons stated above, TransCanada does not believe that this request (as a stand-alone study plan element that would require extremely difficult and costly assessments) ultimately meets ILP Study Criteria 6 and 7.
VANR	In addition to assessing potential effects of operational flows and water level fluctuations on nest abandonment, spawning fish displacement and egg dewatering, the Agency is requesting that the study assess nest scouring as a potential negative impact, as fluctuations in water levels and flow velocities from project operations could potentially cause scouring.	The study plan has been revised to include subsampling of fish nests after eggs hatch and larvae disperse, to assess the amount of silt and sediment, as well as scour in the nests. A subsample of abandoned nests identified during the study will also be included in this assessment.
VANR	The Agency agrees with the licensee's proposed study plan revisions as described [in the summary table of meeting comments and responses].	The study plan revisions reflect stakeholder consultation meetings and discussions held during the 3-month comment period.

Study 16 – Sea Lamprey Spawning Assessment

Commenter	Comment	Response
CRWC	TC plans to chase radio tagged lamprey even if they head up tributaries so documenting other untagged lamprey identified during the same on the ground excursion could take place while looking for the tagged fish. This of course could not apply in cases where the tributary work is done by plane but some effort to identify as many spawning lamprey even if they are in tributaries would be useful information. The same barrier points listed in the American eel studies [Examples of these locations are the falls at Drewsville, NH on the Cold River; the face of the dam in Springfield, VT in the Black River; below the falls at Brockway Mills, VT on the Williams River and at the base of Twin Falls on the Saxtons River] would be useful survey sites.	The study plan has been revised to indicate that we will document locations untagged lamprey that are observed while tracking tagged lamprey. As stated in the Associated Studies section of the plan, other studies including Study 7 (Aquatic Habitat Mapping), Study 10 (Fish Assemblage) and Study 13 (Tributary and Backwater Access and Habitats) will also provide information on presence and potential habitat within the project-affected areas of tributaries.
FWS	The updated PSP has been modified to provide additional clarity on nest sampling protocols and data collection on nests that was requested by the Service and other parties at the study plan meeting on June 6, 2013. We concur with those modifications.	Study plan revisions reflect stakeholder consultation meetings and discussions held during the 3-month comment period.
FWS	Methods: The study proposes use of radio-telemetry to identify lamprey spawning locations in the project areas. We endorse this proposed method. However, given the limited number of radio-tagged lampreys and the large areas of mainstem and tributary rivers that lampreys could disperse to, we recommend that TransCanada also utilize the data from the Hydraulic Modeling Study (Study 4) and Aquatic Habitat Mapping (Study 7) to locate potential areas of lamprey spawning habitat based on substrate and depth criteria or lamprey spawning and incubation.	The study plan has been revised to include references to Study 4 – Hydraulic Modeling in addition to the other associated studies 7, 9, and 13. The Operations Modeling Study (Study 5) will help discriminate between the effects associated with project and non-project flows, and Studies 10 and 17 will allow for a closer evaluation of the results of this study. The study plan has been revised to clarify that wherever spawning lamprey are found, we will attempt to monitor their spawning, and at the least will count the redds.

Commenter	Comment	Response
	During the course of this and other studies, these areas could be observed for lamprey spawning concentrations that may not be identified by the radio-tracking survey if no tagged individuals select those sites. If any such areas offer different habitat conditions from those occupied by tagged individuals, they may be appropriate for inclusion in the nest monitoring phase of the study and/or provide potential unique habitats for evaluation in the Instream Flow Study (Study 9). Addition of this component would strengthen the study plan by providing an alternative method to identify spawning areas and potentially expand the geographic location and habitat conditions that could be evaluated for project effects.	
NHFG	A sample size of 20 sea lamprey for radio tagging seems low.	To clarify the study plan, the intended sample size is 40, 20 (if available) to be collected at the Vernon ladder and 20 (if available) to be collected at the Bellows Falls ladder. TransCanada believes that this sample size together with the high potential for discovering additional habitat and use through other studies will be sufficient in identification of habitat and the assessment of potential project effects.
NHFG	An assessment of sea lamprey spawning success should include a survey for sea lamprey ammocoetes. Sea lamprey ammocoetes may be easily captured by electrofishing as the electricity forces them out of the loose sediment in which they burrow. Sample sites should be selected just downstream from identified spawning areas. Data collected on each individual should include length, weight, and maturity (a certain percentage of individuals will have fully developed eyes and teeth in preparation for migration to the ocean). This survey should be done in late August or September when juvenile sea lamprey are approaching their maximum size for the year.	Stakeholder study requests did not include sampling for ammocoetes, only capping nests and enumerating eggs. Sampling for ammocoetes will not provide an indicator of spawning success. One cannot relate a given ammocoete to a given redd unless the egg hatch is observed, larva is followed to a certain site, and it is observed burrowing into the mud. However, Study 10 (Fish Assemblage) will record any observations of sea lamprey ammocoetes collected through electrofishing.

Commenter	Comment	Response
VANR	The Agency recommends that methods follow Chapter 8 in: Bonar, S. A., W. A. Hubert, and D. W. Willis, editors. 2009. Standard methods for sampling North American freshwater fishes. American Fisheries Society, Bethesda, Maryland. 335 pages; and Gallagher, S.P, P.K. Hahn, and D.H. Johnson. 2007. Redd Counts. Pages 197–234 in D.H. Johnson, B.M. Shrier, J.S. O'Neal, J.A. Knutzen, X. Augerot, T.A. O'Neil, and T.N. Pearsons. Salmonid field protocols handbook: techniques for assessing status and trends in salmon and trout populations. American Fisheries Society, Bethesda, Maryland.	The study plan has been revised to follow and reference the methods suggested by the commenter.
VANR	The licensee is proposing to collect data on redd characteristics including location, size, substrate, depth and velocity. When analyzing substrate the Agency recommends that percent embeddedness be included in the characterization….The Brusven Index describes sediment size and percent embeddedness using a three digit number. The number in the 10s place is the largest materials in the sample termed the dominant particle size. The figure in the ones place represents the material surrounding the dominant particles and the decimal place is used to describe the percent embeddedness (fines). These are standard methods for salmonid redd surveys (Gallagher 2007).	The study plan has been revised to include collecting data on percent embeddedness for characterization using the Brusven index approach.
VANR	The Agency requests that the licensee collaborate with the Agency on the telemetry portion of the study so we can continue to monitor the lamprey once they leave the project affected areas.	The study plan has been revised to clarify that we will notify the resource agencies if/when lamprey leave the study area, and we will provide tag frequency information.
VANR	The Agency agrees with the licensee's proposed study plan revisions as described [in the summary table of meeting comments and responses].	Study plan revisions reflect stakeholder consultation meetings and discussions held during 3-month comment period

Study 17 – Upstream Passage of Riverine Fish Species Assessment

Commenter	Comment	Response
FWS	Study Goals and Objectives: The updated PSP clarifies that fish passage operations to assess passage of riverine fish species will be conducted from early spring to late fall and encompass the entire "open water" period, when freezing temperatures would lead to icing of project equipment. We concur with this time period for the study.	Study plan revisions reflect stakeholder consultation meetings and discussions held during the 3-month comment period.
FWS	Methods: Based on discussions at the June 21, 2013 study plan meeting, the updated plan provides detailed description of the use of video monitoring using the· Salmonsoft digital video counting system. We concur with the proposed counting and monitoring methods.	Study plan revisions reflect stakeholder consultation meetings and discussions held during the 3-month comment period.
FWS	Methods: At the meeting, TransCanada indicated a desire not to have fishway shutdowns and inspections due to the time and logistics of carrying out multiple shutdowns of three fishways. We indicated that although we understood that rationale, we were concerned that debris accumulation in the ladders during extended fishway operations could disrupt ladder hydraulics and affect passage. In response, TransCanada has proposed that inspections of the facility will also include visual observation of the ladders to identify if hydraulic changes occur, and if so, a shutdown, inspection and ladder cleanout may be implemented. While we would agree that most major blockages may be visible on inspection while operating, less dramatic changes in ladder hydraulics may be less obvious. Therefore, we recommend that the three ladders be inspected at the end of the 2013 season, to assess debris accumulation after the spring operation period in 2013, and that this information would be used to evaluate if there is a need for one	The study plan has been revised to include fish ladder inspections at the end of the 2013 season and consultation with the aquatics working group on the need for dewatering and inspection during the study period.

Commenter	Comment	Response
	or more inspection and clean-out during the ladder operation for this study. In addition, we recommend that the study plan require consultation between TransCanada and the Service regarding inspections and TransCanada decisions on whether or not to dewater and inspect the fishways during the study period. This consultation on observation data would assure that the Service and other parties all agree that fishway monitoring results are valid and were not affected by ladder operating conditions.	
VANR	The Agency requested that monitoring in the fish ladders be conducted year round. TransCanada is proposing to operate the upstream fish passage year round or until icing condition make or operations are infeasible because of icing conditions. The proposed schedule indicates that TransCanada will set up the video equipment in April 2014. The proposed study plan should be adjusted to state that TransCanada will operate the fish ladder and setup the video equipment and software as soon as conditions allow which could potentially could occur in March.	The study plan has been revised to state that "equipment will be set up and ladders operated as soon as feasible considering river conditions, ladder and operational conditions during late winter or early spring 2014."
VANR	TransCanada is proposing to continuously monitor water temperature within each of the fish ladders during the study. Fish movement and migration is strongly associated with water temperature. Considering this, the Agency recommends that not only continuous temperature is monitor within the fish ladders, but also within the forebay area where fish exit the ladder and tailrace of each project to assess whether the projects operations are potentially impacting important migratory cues. If potential delays in fish migrations are occurring from project operations effect on temperature, the Agency reserves the right to request a more detailed study in the second year on the temperature within the impoundments at any of the projects.	The study plan has been revised to include placement of 2 additional temperature monitors at each project, in the forebay where fish exit the ladder and in the tailrace, in addition to the temperature monitors in the fish ladders.

Commenter	Comment	Response
VANR	The Agency will work with the licensee and the Salmonsoft company to define terms of use of the software and video monitoring equipment (with the exception of state owned computers).	The study plan has been revised to include provisions for purchasing additional computers. TransCanada appreciates the Agency's willingness to work collaboratively on our use of the Salmonsoft software.

Study 18 – American Eel Upstream Passage Assessment

Commenter	Comment	Response
CRWC	[This comment was a combined comment for studies 11, 18, 29 and 20]. If the sampling numbers are sufficient to generate useful data using eel pots, then the fieldwork should rely on eel pots as much as possible to reduce harm to eels during sampling. One note is that there is a higher level of damage to eels captured with electro shocking than there are with eel pots. (James B. Reynolds and F. Michael Holliman, 2003). In order to get the fullest picture of the presence of American eels in the CT River watershed, eel sampling should take place at several migration barrier locations on the tributaries even though they are outside the immediate influence of the project operations. Examples of these locations are the falls at Drewsville, NH on the Cold River; the face of the dam in Springfield, VT in the Black River; below the falls at Brockway Mills, VT on the Williams River and at the base of Twin Falls on the Saxtons River.	TransCanada concurs with the first half of this comment and notes that the study plan calls for collecting eels in eel pots in the first study year, and eel trap passes if needed, in the second study year. The purpose of this study is to assess presence/abundance of American eel at project tailrace and spillway locations in order to identify areas of concentration of eels staging or attempting to pass upstream of the Projects. The study area, therefore, does not include tributaries.
FWS	Study Goals and Objectives: In response to concerns raised by the Service at the May 23, 2013 study plan meeting, TransCanada has modified the study design to conduct the systematic surveys in study year one and deploy the temporary eel trap passes in study year two (rather than perform both tasks in the same study year). The Service supports this change.	Study plan revisions reflect stakeholder consultation meetings and discussions held during the 3-month comment period.

Commenter	Comment	Response
FWS	Methods: <u>Temporary/Portable Eel Trap Passes</u> - TransCanada states that "Prior to the installation of any temporary eel trap passes during year one..." The Service believes this should read "...during year two." Regardless, we support the general point of the sentence that TransCanada will consult with the Aquatics Working Group prior to selecting locations to deploy the eel trap passes. The Service is concerned with TransCanada's proposal to limit the number of eel trap passes to two per project. Given the number of possible areas of concentration at each project, it is possible that more than two eel trap passes will be needed. The Service recommends that the number of eel trap passes required at each project be determined in consultation with the Aquatics Working Group, based on the results of the systematic surveys conducted in year one.	The study plan has been revised to read "during year two" relative to installation of eel trap passes. The study plan has been revised to state that we will consult with the aquatics working group after year one to determine the number of eel passes needed during year two.
NHFG	Any eels sampled should be marked (fin clip, elastomer?) in order to avoid data replication and also to possibly be able to make a population estimate. More could be learned by marking and releasing eels captured in eel traps than from relocating the eels upstream. This may allow for a population estimate or at least some basic movement data.	The study plan has been revised to include marking captured eels with elastomer tags to report re-captures and avoid data replication. However, do not believe that this information will be able to provide a population estimate.
VANR	During the study plan meetings, it was suggested by FERC that the licensee mark all captured eels to avoid double counting. The licensee has since proposed to pass all captured eels upstream, thereby alleviating agency concerns over recaptures impacting estimates of eel congregations below projects. However, the Agency feels that there is value to marking eels (e.g. elastomer tags) with the goal of obtaining information on movement (e.g. duration between dams, percent passed by dam, number recaptured). The Agency	The study plan has been revised to include marking captured eels with elastomer tags to report re-captures and avoid data replication.

Commenter	Comment	Response
	requests that the licensee consider marking eels with elastomer tags to obtain this information.	
VANR	The Agency agrees with the licensee's proposed study plan revisions as described [in the summary table of meeting comments and responses] with the addition of marking the eels.	Study plan revisions reflect stakeholder consultation meetings and discussions held during the 3-month comment period.

Study 19 – American Eel Downstream Passage Assessment

Commenter	Comment	Response
CRWC	[This comment was a combined comment for studies 11, 18, 19 and 20]. If the sampling numbers are sufficient to generate useful data using eel pots, then the fieldwork should rely on eel pots as much as possible to reduce harm to eels during sampling. One note is that there is a higher level of damage to eels captured with electro shocking than there are with eel pots. (James B. Reynolds and F. Michael Holliman, 2003). In order to get the fullest picture of the presence of American eels in the CT River watershed, eel sampling should take place at several migration barrier locations on the tributaries even though they are outside the immediate influence of the project operations. Examples of these locations are the falls at Drewsville, NH on the Cold River; the face of the dam in Springfield, VT in the Black River; below the falls at Brockway Mills, VT on the Williams River and at the base of Twin Falls on the Saxtons River.	TransCanada interprets this comment as being related to Study 11 or perhaps Study 18 but not Study 19 as we have not proposed any field sampling and continue to propose none. American eels used in this study are proposed to be collected at either the Turners Falls or Holyoke bypass samplers, or as suggested by the resource agencies, from out-of–basin if needed to meet the sample size requirements.
FWS	Methods: FirstLight states that mortality and injury of silver eels may be assessed at non-turbine routes (as recommended by the Service and others), depending on the results of the route selection study; if a "significant" proportion of fish use non-turbine routes,	We have revised the study plan replacing the term "significant" with "substantial". We have also revised the plan to indicate that we will consult with the working group on the need for future

Commenter	Comment	Response
	TransCanada will consult with the Aquatics Working Group and consider options to assess those routes. The word "significant" is somewhat ambiguous unless it is being used in the statistical sense, which we do not think is the case for the subject study; therefore, we recommend replacing it with the word "substantial." However, as we noted on the June 21, 2013 conference call on various studies, without assessment of spill survival, there will be no information to compare that passage route with turbine passage. If turbine passage proves to inflict high mortality, there will be no information upon which to evaluate if spilling water at the dam might provide a safer alternative route and potentially suggest a way to mitigate for project impacts. This assessment would likely be needed later if that is the case, and it may be more economical to do this assessment concurrently with the other survival evaluations in addition to putting eel survival through the turbines in context of other routes.	testing if the route selection portion of the study indicates that a significant proportion of fish use the spillways and/or passage facilities and this results in low survival.
FWS	Methods: <u>Route Selection</u> - TransCanada states that radio-tagged eels will be monitored from late August through mid- October. The Service recommends that monitoring continue until all test eels are confirmed to have left the study area (or the tag life has expired, whichever occurs first).	The study plan has been revised to specify that eels will be monitored until all have either left the study area or tag life has expired.
FWS	Methods: <u>Survival/Injury Studies-</u> In this section, TransCanada states that a minimum of 50 eels with HI-Z Turb'N tags will be released at each project, with the exact number to be determined in consultation with the Aquatics Working Group. However, earlier in the plan, TransCanada stated that it will proportionally allocate the number of eels tested (150) by the number of different turbine types. The Service recommends that a minimum of 50 tagged eels be	TransCanada interpreted the original study request of “a minimum of 50 tagged eels…at each location” to mean that the agency was requesting 50 per project. The study plan has been revised to state that a total of 300 eels will be used in the study, distributed as follows: 1. 100 or50 eels per each of two turbine types at Wilder

Commenter	Comment	Response
	released into each turbine type, per project. Given that there is one turbine type at Bellows Falls, two types at Wilder, and three types at Vernon, a total of 300 test eels would be needed. This is the number of eels FirstLight proposes to use in its balloon tag study, and the number the Service used in its study request ("A minimum number of 50 tagged eels...will be required at each location…"). According to the updated PSP, eels would be injected into the turbines while at or near full generation. The Service is concerned that restricting the test to one operational condition may be insufficient to evaluate overall turbine mortality. If peak efficiency is at a flow less than full generation, that condition also needs to be evaluated. Likewise, if the units sometimes are operated at minimum gate, that also needs to be evaluate. Testing at these other loads is necessary, as turbine survival is known to vary depending on turbine unit operations. However, if TransCanada provides data showing that the turbines only operate at one setting for the duration of the adult eel outmigration period, testing only that one condition will suffice.	2. 50 eels at Bellows Falls as all turbines are the same 3. 150 or 50 eels per each of three turbine types at Vernon. We will examine operational data and present an evaluation of unit loading conditions to the working group prior to making final unit loading determination(s) for each set of released fish.
FWS	Analysis: <u>Route Selection -</u> If analysis of the routing data indicates preference for spill routes and resultant poor survival, additional consultation with the Aquatics Working Group would take place to discuss the need for additional survival estimates and studies. Given that the proposed radio telemetry tags would not have a motion sensor or other mechanism from which to determine the fate (i.e., alive or dead) of the eel, it likely would be difficult to use the information to assess survival (which is why a separate directed mortality study was requested).	We have revised the plan to indicate that we will consult with the working group on the need for future testing if the route selection portion of the study indicates that a significant proportion of fish use the spillways and/or passage facilities and this results in low survival We respectfully disagree. It is possible that any mortality or injury would be latent and not immediate, and could occur far down stream well outside of the study area, so motion sensing tags would not be useful in this case. However, FirstLight is also conducting a similar study and shared tag frequency information will help to determine mortality between Vernon and the

Commenter	Comment	Response
		FirstLight projects.
FWS	Deliverables: All data used to develop the report should be made available to stakeholders (upon request) in digital format, including all telemetry and PIT tag data.	The study plan has been revised to state that "study related data will be made available to stakeholders upon written request."
NHFG	It should not be assumed that eel passage over spillways is high as all spillways are different and simply visually observing flow going over a spillway does in no way inform fish survival. Eel survival over spillways at all dams should be examined.	We have revised the plan to indicate that we will consult with the working group on the need for future testing if the route selection portion of the study indicates that a significant proportion of fish use the spillways and/or passage facilities and this results in low survival
NHFG	All turbine types at each dam should be tested.	The study plan has been revised to state that all turbine types will be evaluated with 50 fish each at each respective project (2 at Wilder, 1 at Bellows Falls and 3 at Vernon).
VANR	In the licensee's proposed study plan the objectives of this study are to 1) quantify the movement rates (including timing) and relative proportion of eels passing via various routes at the projects including through the turbines, the Bellows Falls bypassed reach, the current downstream passage facilities, and spillways; and 2) assess instantaneous and latent mortality and injury of eels passed via each route. These objectives are misleading because they are not assessing mortality through spillway and downstream passage facilities because it is assumed survival is high. Therefore objective 2 should state assess instantaneous and latent mortality and injury of eels passed <u>through each turbine type.</u>	The study plan has been revised to clarify the language in objective 2, limiting the scope of the survival portion of the study to each turbine type at each project.

Study 20 – American Eel Downstream Migration Timing Assessment

Commenter	Comment	Response
CRWC	[This comment was a combined comment for studies 11, 18, 19 and 20]. If the sampling numbers are sufficient to generate useful data using eel pots, then the fieldwork should rely on eel pots as much as possible to reduce harm to eels during sampling. One note is that there is a higher level of damage to eels captured with electro shocking than there are with eel pots. (James B. Reynolds and F. Michael Holliman, 2003). In order to get the fullest picture of the presence of American eels in the CT River watershed, eel sampling should take place at several migration barrier locations on the tributaries even though they are outside the immediate influence of the project operations. Examples of these locations are the falls at Drewsville, NH on the Cold River; the face of the dam in Springfield, VT in the Black River; below the falls at Brockway Mills, VT on the Williams River and at the base of Twin Falls on the Saxtons River.	TransCanada interprets this comment as being related to Study 11 or perhaps Study 18 but not Study 20 as we have not proposed any field sampling and continue to propose none for this study.
FWS	At the May 23, 2013 study plan meeting, the VDFW suggested that data from Study 17 (Upstream Passage of Riverine Species Assessment) could be used to inform the subject study. The updated PSP addresses this suggestion. The Service supports incorporating relevant data from other studies being conducted either at TransCanada's projects or FirstLight's projects, once they become available. In particular, the hydroacoustic data that FirstLight will collect both at the Northfield Mountain Pumped Storage (NMPS) and the Turners Falls projects could provide valuable information regarding the timing of eel outmigration on the Connecticut River.	The study plan has been revised to reflect the incorporation of pertinent results and data collected from other TransCanada studies, and to the extent available from First Light studies.

Commenter	Comment	Response
FWS	Schedule: The updated PSP indicates that the study will occur in 2014. While the literature review portion of the study could be conducted in 2014, the final report, if it is to incorporate data collected from other studies, will not be finished until late in 2014. Therefore, the study likely will not be completed until 2015. Alternatively, TransCanada could release a draft report in 2014, and a revised report in 2015 once information from other relevant studies becomes available.	The study plan schedule has been revised to clarify that the study will be conducted in 2014, an interim report will be provided in 2014, and additional analysis and final report will be provided in 2015 that incorporates whatever additional data from other studies is available.
NHFG	In Study Goals and Objectives, third paragraph, add the following [underlined]: There are few American eel upstream of the TransCanada projects in the <u>mainstem Connecticut River</u>, as indicated by annual electrofishing conducted in the lower portion of Vernon impoundment by Entergy Nuclear Vermont Yankee…	The study plan has been revised to specify "within the mainstem Connecticut River".
NHFG	In Project Nexus add the following [underlined]: Currently the TransCanada projects have little, if any, direct effect on the overall outmigration of Connecticut River American eel because so few eels exist upstream of the TransCanada projects in the <u>mainstem Connecticut River.</u> [in the next comment, NHFG suggests deleting the statement: "Currently the TransCanada projects have little, if any, direct effect on the overall outmigration of Connecticut River American eel because so few eels exist upstream of the TransCanada projects." For one, we do not know how many eels exist upstream of the TransCanada projects. Secondly, if there are less eels, one could interpret this as meaning TransCanada could have more of an impact on their population.	The study plan has been revised to specify "within the mainstem Connecticut River".
NHFG	There is disagreement with the logic that there are not enough eels to do anything but a literature review. We have no idea how many eels may be in the lakes and Ponds upstream of the projects. I think that fyke nets	TransCanada interprets this comment as being related to Study 11 or perhaps Study 18 but not Study 20 as we have not proposed any field sampling and continue to propose none for this study.

Commenter	Comment	Response
	or some other traps should be set at the mouth of the tributaries or any pinch point where eels may be captured. This would tell us as much, or more, than the eel survey about the number of eels upstream of the projects. Any eels captured would be better candidates for telemetry studies than the eels captured downstream at Holyoke. There are eels in Lake Winnipesauke, which has a total of 9 dams downstream.	
VANR	The licensee states in its study plan (pg. 189), "However, it finds that a field study is premature at this time. There are few American eel upstream of the TransCanada projects, as indicated by annual electrofishing conducted in the lower portion of Vernon impoundment as summarized in the Vernon PAD, and collections made by Yoder et al. (2009) above the Bellows Falls and Wilder dams." Considering there have been no targeted eel surveys in riverine and lacustrine habitat on the Lower Connecticut River as well as in the ponds and tributaries of the Connecticut River basin, it is unknown how many eels are residing within and/or outside of project bounds. As such the Agency requests that this statement be revised as follows, "There have been few documented American eel upstream of the TransCanada projects in the mainstem Connecticut River, as indicated by annual electrofishing conducted in the lower portion of Vernon impoundment and as summarized in the Vernon PAD, and collections made by Yoder et al. (2009) above the Bellows Falls and Wilder dams".	The study plan has been revised to specify "within the mainstem Connecticut River".
VANR	Similarly, the project nexus states (pg. 192), "Currently the TransCanada projects have little, if any, direct effect on the overall outmigration of Connecticut River American eel because so few eels exist upstream	The study plan has been revised to specify "within the mainstem Connecticut River".

Commenter	Comment	Response
	of the TransCanada projects". The Agency requests that this statement be removed because it is unknown how many eels exist upstream of the TransCanada projects. As stated above, sampling efforts will likely underestimate the distribution and abundance of the eels because the scope is limited to the mainstem of the Connecticut River. This should be accounted for in the analysis.	
VANR	The Agency does not agree with section B as described [in the summary table of meeting comments and responses wherein the meeting comment B was "*Consider extending scope of the study into the tributaries of the CT River."* And TC's response was *"TC does not intend to expand the geographic scope of this study to include an assessment of American eel in tributary waters. TC considers this expansion to be a request to perform species management analyses rather than a study to determine the effect of project operations on American eel migration timing.*]	The methods for this study include a thorough review of literature that encompasses "the Connecticut River Basin and other rivers in the Northeast…" This necessarily includes literature related to tributaries, to the extent such literature exists and is available. The plan also references associated studies including the other eel studies, Fish Assemblage Study (Study 10), Upstream Passage of Riverine Fish Species Assessment (Study 17), and Aquatic Habitat Mapping (Study 7) as well as any available FirstLight data that will provide information on eels in tributaries affected by project operations.

Study 21 – American Shad Telemetry Study - Vernon

Commenter	Comment	Response
FWS	Methods: The updated Methods section includes more planning details that will occur in consultation with the Aquatic Working Groups. There is a statement that tagged shad will be manually tracked and spawning areas located, but it is not stated at what frequency mobile tracking will occur. Given the length of the reach from Bellow Falls to Vernon, we expect that the entire reach could be covered in one day, therefore we are assuming that the entire reach will be surveyed.	The study plan has been revised to clarify that the stretch of river between Vernon and Bellows Falls will be tracked every other day and that when fish are observed to be holding around areas that appear suitable for spawning and water temperatures are conducive, those areas will be manually monitored more and nighttime observation periods will commence."

Commenter	Comment	Response
	This point should be clarified. Consistency with previous study approaches used by Conte Laboratory will be beneficial as will the additional review of study data from 2011 and 2012.	
FWS	Radio receiver and PIT reader coverage appears well designed to meet study objectives and is shown in figures and described in detail. The use of motion and temperature reporting tags was requested and has been incorporated.	Study plan revisions reflect stakeholder consultation meetings and discussions held during the 3-month comment period. However, the study plan has been changed to remove some references to the specific types and quantities of receiving equipment since we cannot fully specify them until the 2012 USGS data has been analyzed. The receiver coverage is as described and shown in the Updated Proposed Study Plan (revision date 07/08/13), but the number and types of receivers may change to ensure adequate coverage.
FWS	Methods: Sample sizes of tagged shad were increased from the original proposal to include 50 double tagged (radio/PIT) shad from Holyoke for release in the upper Turners Falls Dam Pool. A matching pair of 50 single PIT-only tagged shad will also be released in this area. As noted with FirstLight Power's shad telemetry plans, fallback of shad from trapping, handling, tagging, and transport may reach 40 percent. This would potentially mean that there will be only 30 radio (double-tagged) shad remaining for study. As noted, it is expected that FirstLight study fish, with coordinated radio tag frequencies, code sets, and codes will supplement this number. Therefore, we recommend increasing the proposed sample size to allow for evaluation of study objectives over the entire upstream shad run at Vernon and associated varied operational and environmental conditions.	The study plan has been revised to acknowledge the issue of fallback, and we note therein that Castro-Santos (2011) had 90% of radio tagged shad arrive at the Vernon downstream monitor (the lower boundary of TC's study area) from Turners Gatehouse in 2011. TransCanada proposes to tag shad with methods similar to Castro-Santos so as to minimize the handling related effects. As noted in the comment, we expect that FirstLight study fish will supplement the sample size for this study and that the resulting sample size will be sufficient to meet the study goals and objectives while balancing the potential for data loss through signal collisions. Once the USGS 2012 data has been analyzed in 2013 as part of this study, and if it suggests a greater sample size may be needed to gain meaningful information, we will consult with the aquatics working group on modifying the sample size.
FWS	Methods: The methods include no discussion of the timing of tagged fish releases. Shad should not be released in a limited time window. Spreading out	The study plan has been revised to state: "Shad will be tagged and released in lots of 20, 20, and 10 both below and above Vernon Project to reflect the early,

Commenter	Comment	Response
	releases would reduce concerns about radio tag code collisions and allow for increased sample sizes to be released in three batches. However, we also recommend shifting the release periods to the early and middle parts of the run to avoid the increased losses of fish that occur with later releases. At the May 23, 2013 meeting, TransCanada stated that restricting the number of releases was not based on the cost of additional radio tags, but rather to assure the quality of the data. We believe that additional quality data can be obtained if the study design is modified to include three batch releases of 30-40 double-tagged fish per batch (with paired single PIT-tagged fish) to accounting for fallbacks. Releases could be spaced at ten-day intervals, spanning the month of May.	mid, and later portion of the shad migration period." We note that sample size will likely be supplemented by FirstLight study fish. FirstLight study fish will supplement the sample size for this study and that the resulting sample size will be sufficient to meet the study goals and objectives while balancing the potential for data loss through signal collisions. Once the USGS 2012 data has been analyzed in 2013 as part of this study, and if it suggests a greater sample size may be needed to gain meaningful information, we will consult with the aquatics working group on modifying the sample size.
FWS	Methods: The planned release of 50 double tagged shad into Vernon Dam Pool should be adequate with recent observed passage rates and the suggested increase in study fish releases below Vernon, with the additional fish from FirstLight also supplementing the available sample. As noted with the releases below Vernon, several release groups would be desirable upstream of Vernon to better represent variable and changing conditions (operational and environmental) over the period of early May to early June.	The study plan has been revised to state: "Shad will be tagged and released in lots of 20, 20, and 10 both below and above Vernon Project to reflect the early, mid, and later portion of the shad migration period."
FWS	Methods: The study proposes nighttime observation periods for spawning activity that will commence once radio-tagged shad are detected and suitable water temperatures are occurring upstream of Vernon Dam. Observations are proposed to occur every night after that trigger is reached but the duration of the monitoring each night is not specified. Existing literature indicates that shad spawning does not extend very late into the night, therefore rather than setting specific hours of observation, we recommend	The study plan has been revised to clarify that observation periods will commence prior to dusk and continue until observed spawning activity has ceased for the night.

Commenter	Comment	Response
	that the updated PSP indicate that observations will continue until spawning ceases each night.	
FWS	Analysis: The outlined analyses appear appropriate. All data used to develop the report should be made available to stakeholders (upon request) in digital format, including all telemetry and other data.	The study plan has been revised to state: "Study related data will be made available to stakeholders upon written request."
NHFG	A sample of fish from the early, middle and late part of the run should be tagged. All tags should have "mortality add-ons" and sample sizes of tagged fish should be as high as budget allows. Fish should be tagged below Turners Falls and allowed to proceed upstream "naturally" so that fish examined at Vernon have the typical experience/history of shad that would normally be in that stretch of the river. In the study plan, only manual tracking above Vermont Yankee is proposed, but that will not help determine if Bellows Falls operations are influencing fish migration, etc… Stationary receivers need to be deployed between Vermont Yankee and Bellows Falls.	The study plan has been revised to: • Specify collection, tagging and releasing of fish during the early, middle and late portions of the run. • Include mortality and temperature radio tags. • Consider the need for an increased sample size based on analysis of the 2012 data and working group consultation. • Include stationary radio receivers in the Bellows Falls bypassed reach downstream of the fish barrier dam and in the Bellows Falls tailwater as described and as shown in Figure 21-2 of the plan. Fish will be tracked every other day between Vernon and Bellows Falls, thus additional receivers in that reach are not needed to collect data on fish movement. We respectfully disagree that fish should be released below Turners Falls as this would undoubtedly decrease the sample size that arrives at Vernon because some may not get above Turners Falls and may want to spawn elsewhere, and thus would only provide benefits to FirstLight studies. If it is critical for shad to experience FirstLight Projects then FirstLight's studies should include an increased number in order to provide a reasonable number of fish that make it to Vernon.
VANR	In the licensee's revised study plan in the Method Section (pg. 201) states, "Tagged shad will be manually tracked and spawning areas located." It does not state as to what frequency tracking in the area	The study plan has been revised to clarify that the stretch of river between Vernon and Bellows Falls will be tracked every other day and once fish are observed holding around areas that appear suitable for spawning

Commenter	Comment	Response
	between Vernon and Bellows Falls will occur. The Agency recommends that the methods and frequency of tracking be consistent with previous study approaches used by Conte Laboratory which will be beneficial in the additional review of study data from 2011 and 2012, as noted.	and once water temperatures are conducive, those areas will be manually monitored and nighttime observation periods will commence.
VANR	The Agency requests that tagged individuals be selected from the early, middle and late part of the run to fully represent the breadth of the run. Incorporating mortality add-ons would provide more conclusive results related to the project's impacts on survival.	The study plan has been revised to: • Specify collection, tagging and releasing of fish during the early, middle and late portions of the run. • Include mortality and temperature radio tags.
VANR	As noted, it is expected that FirstLight and TransCanada will coordinate so radio tag study fish, will share radio tag frequencies, code sets, and codes. The Agency requests that fish be tagged below Turners Falls and be allowed to proceed upstream as they would naturally. This will give the Agency a better idea of the condition that these fish are in and experience as they migrate upstream through the projects.	We respectfully disagree that fish should be released below Turners Falls as this would undoubtedly decrease the sample size that arrives at Vernon because some may not get above Turners Falls and may want to spawn elsewhere, and thus would only provide benefits to FirstLight studies. If it is critical for shad to experience FirstLight Projects then FirstLight's studies should include an increased number in order to provide a reasonable number of fish that make it to Vernon.
VANR	In order to determine if Bellows Falls operations are affecting American shad spawning site use and availability, spawning habitat quantity and quality, and spawning activity downstream of the Bellows Falls Project the Agency requests that stationary receivers be deployed between the lower Vernon impoundment and Bellows Falls Project.	The study plan has been revised to include stationary receivers in the Bellows Falls bypassed reach downstream of the fish barrier dam and in the Bellows Falls tailwater as described and as shown in Figure 21-2 of the plan.

Study 22 – Downstream Migration of Juvenile Shad - Vernon

Commenter	Comment	Response
CRWC	TC should study all of the impediments to successful shad spawning and downstream migration including evaluation of the effect of the heated water discharge plume from Vermont Yankee. The study should determine if the plume affects the choice of juvenile shad's downstream passage route, migrant residence time in Vernon pool attributable to the thermal plume and any effects on the timing of shad migration. The study should recommend if the change in the location of the fish passage tube would improve fish passage.	TransCanada respectfully notes that shad spawning is included in Study 21 – American Shad Telemetry Study. We disagree with the commenter's suggestion that the goal of this study is to study all potential impediments to downstream migration. Rather, as stated in the study plan, the goal is to assess whether Vernon Project operations affect the safe and timely passage of emigrating juvenile shad. This additional scope does not meet ILP Study Criterion 5 in terms of nexus to the project and would not inform development of future license requirements. If study results indicate that changes or improvements to passage facilities are warranted, those recommendations would be part of enhancement or mitigation measures and beyond the scope of this study.
CRWC	TC should place more than one temperature logger transect above the Vermont Yankee discharge and more than one between the Entergy discharge and the Vernon dam in order to better differentiate between potential impacts of Vermont Yankee and TransCanada on water temperature. (Same as recommendation under Study 6). TC should develop a metric for shad migration delay relative to the effects of the thermal plume.	TransCanada respectfully disagrees that additional temperature monitoring stations are necessary to meet the goal and objectives of this study. We note that this study includes collection of data on air temperature, water temperature, turbidity, rainfall, river flow, and lunar phase. In addition, Study 6 – Water Quality Monitoring, will collect data on temperature data above and below the Vermont Yankee discharge for the purpose of identifying potential effects of Vernon Project operations on temperature. That data will help to inform this study's results. We disagree that developing a metric for shad migration delay, even if possible to do, is needed to

Commenter	Comment	Response
		achieve this study's goal and objectives. We believe that the revised study plan will provide sufficient information to assess whether Vernon Project operations affect the safe and timely passage of emigrating juvenile shad. TransCanada believes that the requested additional study scope on its own does not meet the ILP Study Criteria in the context of what we are proposing. The information it will provide as "existing information" does not meet Criterion 4. The methodology we are proposing in the current study plan, absent the additional scope being requested, is generally accepted practice in the scientific community or appropriate and therefore the additional scope is not necessary to meet Criterion 6. The additional scope on its own has a cost and effort that does not warrant inclusion when compared to what we are proposing (the alternative) and therefore does not meet Criterion 7.
FWS	Study Goals and Objectives: In response to feedback provided by stakeholders at the May 23, 2013 study plan meeting, TransCanada has modified the goals and objectives of this study. The Service believes the updated goals and objectives address some of the concerns raised at the meeting.	Study plan revisions reflect stakeholder consultation meetings and discussions held during the 3-month comment period.
FWS	Methods: The updated Methods section includes the addition of video monitoring to assess the timing of the juvenile shad outmigration. This new method was proposed in response to the Service raising a concern with relying solely on radio-tagged juveniles and Turbine Tag juveniles that may or may not represent the natural timing, duration, and magnitude of wild fish outmigration(s) and the operational/environmental conditions that are occurring in those periods of natural movement. The Service recommended the use of hydroacoustics in the Vernon Darn forebay to quantitatively determine timing, duration, and	The study plan has been revised to add a single beam hydroacoustic transducer in the Vernon forebay in the vicinity of the downstream fishpipe to better describe the timing, duration and relative abundance of the American shad downstream migration. Periodic net sampling (but not underwater video) will be used to verify the species and size composition of the acoustically detected shad. We note that neither the study objectives nor stakeholder study requests included quantitative assessment of the absolute magnitude of the juvenile

Commenter	Comment	Response
	magnitude of the juvenile outmigration, which would provide important context to the limited number and release timeframe of radio-tagged juvenile fish releases.	shad run, as the comment implies. That type of assessment would be prohibitively costly and is unnecessary to assess whether project operations affect the safe and timely passage of emigrating juvenile American shad.
FWS	Methods: The May 23, 2013 meeting stimulated significant discussion on the topic of hydroacoustic evaluations used at Vernon in an unsuccessful juvenile shad study in 2009 [additional comments relative to hydroacoustics and statements by Hydroacoustic Technology Incorporated (HTI)]… despite the disappointing results of the 2009 study, properly deployed hydroacoustic transducers would provide quality data to address the study objectives. We note that as part of their relicensing studies, FirstLight is proposing installation of hydroacoustic equipment at Cabot Station and the canal Gatehouse at the Turners Falls Project and at the Northfield Mountain Pumped Storage intake to assess juvenile shad outmigration. The goals and objectives of those studies are the same as the goals and objectives of this study at Vernon.	The study plan has been revised to add a single beam hydroacoustic transducer in the Vernon forebay in the vicinity of the downstream fishpipe to better describe the timing, duration and relative abundance of the American shad downstream migration. Periodic net sampling (but not underwater video) will be used to verify the species and size composition of the acoustically detected shad.
FWS	Methods: The use of a camera(s) has been proposed by TransCanada in lieu of a hydroacoustic study. However, a camera mounted on the bypass entrance has potential drawbacks due to the inability to discern images during periods of reduced visibility from turbid conditions. Hydroacoustic imaging can function in turbid conditions. Also, the field of vision for a single camera does not compare to the area of coverage that can be provided by acoustic transducers that can effectively create a detection screen. Juvenile shad outmigration is believed to be triggered by higher flow events, which are associated with high turbidity. As we noted at the May 23, 2013 meeting, hydroacoustic technology would also be of use in assessing silver eel outmigration study objectives (timing, duration, magnitude) as that period overlaps with juvenile shad.	The study plan has been revised to add a single beam hydroacoustic transducer in the Vernon forebay in the vicinity of the downstream fishpipe to better describe the timing, duration and relative abundance of the American shad downstream migration. Periodic net sampling (but not underwater video) will be used to verify the species and size composition of the acoustically detected shad. We note that neither the study objectives nor stakeholder study requests included quantitative assessment of the absolute magnitude of the juvenile shad run, as the comment implies. That type of assessment would be prohibitively costly and is unnecessary to assess whether project operations affect the safe and timely passage of emigrating

Commenter	Comment	Response
	Analyses of hydroacoustic data would substantially improve our understanding of project impacts and inform any potential mitigative measures.	juvenile American shad.
FWS	Methods: The Service supports the addition of 150 study fish to evaluate a Francis turbine unit as we had requested at the May 23, 2013 meeting. Turbine mortality/survival studies with tagged juvenile shad proposed to be conducted at full or near full generation. However, turbine mortality varies with turbine unit generation and efficiency. Therefore, the Service believes that if the units will operate at less than full hydraulic capacity that is the condition that needs to be evaluated. Likewise, if the units are always operated at peak efficiency, those conditions should be evaluated. If the units are operated over a range of efficiencies, all conditions should be evaluated (maximum gate, peak efficiency, and minimum gate).	As with Study 19 – American Eel Downstream Passage, we will examine operational data and present an evaluation of unit loading conditions to the working group prior to making final unit loading determination(s) for each set of released fish.
FWS	Deliverables: All data used to develop the report should be made available to stakeholders (upon request) in digital format, including all telemetry and other data.	Study related data will be made available to stakeholders upon written request.
NHFG	The applicant does not want to do a turbine mortality study on the Francis turbines (units 1-4) because a previous study found only 10% of Atlantic salmon smolts passed through these units and that project mortality by this route will be minimal. We cannot assume that juvenile shad will take the same routes as smolts. They should use the 2014 route selection study to see if their above assumptions are true in terms of route selection and if their assumptions are false, they should do a turbine mortality study on Units 1-4 in 2015.	The study plan has been revised to include testing of one of the Francis units 1-4 as well as one of the Kaplan units 5 - 8.
NHFG	It will be best if study fish are collected above the Vernon Dam so that difference in migration timing between up and downstream fish do not bias results.	The study plan has been revised to indicate our preference for using hatchery fish if they are available in the number and size needed for this study. However, in the event that sufficient numbers of

Commenter	Comment	Response
		hatchery fish are not available, the revised plan includes a possible collection location upstream of Vernon.
NHFG	Hydroacoustics was ruled out due, in part, to the noise and turbulence around the dam. A hydroacoustic transducer oriented across the water column at location far enough upstream of the dam to minimize interference would provide important data on the total number of juvenile shad moving into the project. This would increase the value of the video monitoring data collected at the bypass by providing a better estimate of the number of fish that use the bypass as a percentage of the total number of fish that migrated into the project area.	The study plan has been revised to add a single beam hydroacoustic transducer in the Vernon forebay in the vicinity of the downstream fishpipe to better describe the timing, duration and relative abundance of the American shad downstream migration. Periodic net sampling (but not underwater video) will be used to verify the species and size composition of the acoustically detected shad.
NHFG	Care should be taken in interpreting the results in relation to any impacts Vermont Yankee's thermal discharge may be having on juvenile shad route selection, timing and migration rates. As such, additional temperature loggers in this general area would be useful (see comments on Study 6).	We believe that additional temperature monitoring stations are not necessary to meet the goal and objectives of this study. We note that this study includes collection of data on air temperature, water temperature, turbidity, rainfall, river flow, and lunar phase. In addition, Study 6 – Water Quality Monitoring, will collect data on temperature and other water quality parameters above and below the Vermont Yankee discharge for the purpose of identifying potential effects of Vernon project operations on temperature. That data will help to inform this study's results. TransCanada believes that the requested additional study scope on its own does not meet the ILP Study Criteria in the context of what we are proposing. The information it will provide as "existing information" does not meet Criterion 4. The methodology we are proposing in the current study plan, absent the additional elements being requested, is generally accepted practice in the scientific community or appropriate and therefore the additional scope is not necessary to meet Criterion 6. The additional scope on

Commenter	Comment	Response
		its own has a cost and effort that does not warrant inclusion when compared to what we are proposing (the alternative) and therefore does not meet Criterion 7.
NHFG	There are concerns about the 110 mm minimum size and the 8 day tag life. A size bias in the data may down play the role of predation and possibly over-estimate the turbine mortality. With a short tag life, you run the risk of tagging fish that are not actively migrating. It may be difficult to find an adequate number of large individuals for tagging. That said, wild fish should be preferred over hatchery fish, which may behave differently than wild fish collected from the river.	The study plan has been revised to clarify that we will attempt to tag as large juveniles as possible but will not tag shad <110 mm, that being the minimum size proposed. The study plan has been revised to indicate our preference for using hatchery fish if they are available in the number and size needed for this study. However, in the event that sufficient numbers of hatchery fish are not available, the revised plan includes a possible collection location upstream of Vernon.
VANR	In order to gain a better understanding of fish movement patterns with respect to seasonality, flow conditions, and temperature conditions, the Agency requests that hydroacoustic assessment technology be employed. The use of hydroacoustics in the forebay will provide a more accurate picture of the timing, duration, and magnitude of juvenile shad migration through the Vernon project as well as assess the timing and duration of other migrator species such as American eels.	The study plan has been revised to add a single beam hydroacoustic transducer in the Vernon forebay in the vicinity of the downstream fishpipe to better describe the timing, duration and relative abundance of the American shad downstream migration. Periodic net sampling (but not underwater video) will be used to verify the species and size composition of the acoustically detected shad. We note that neither the study objectives nor stakeholder study requests included quantitative assessment of the magnitude of the juvenile shad run, as the comment implies. That type of assessment would be prohibitively costly and is unnecessary to assess whether project operations affect the safe and timely passage of emigrating juvenile American shad.

Study 23 – Fish Impingement, Entrainment and Survival Study

Commenter	Response	Commenter
CRWC	The fish impingement and entrainment study should begin in 2014 with the results of the desktop work prepared in such a way that field generated information gathered in 2014 can easily and quickly be applied to the fish species identified in the project reach of the river.	TransCanada does not propose to alter the schedule for conducting this study which is expected to take place after the results of the fish assemblage study (Study 10) are available. Findings from the associated studies (Studies 19, 20, 21, and 22) may also provide useful insight into the determination of survival for diadromous fish species. There is sufficient time within the ILP study schedule to perform this study's analysis, relative to the species identified in the above studies, and to prepare draft and final reports.
FWS	Existing Information and Need for Additional Information: While TransCanada cites a number of passage route entrainment studies, it should be noted that, with the exception of one study by Normandeau (1996), the focus of all of the other studies was on a single species: Atlantic salmon.	TransCanada acknowledges the comment, and that this information serves as part of the existing information available.
FWS	Methods: TransCanada proposes to use existing literature along with the site-specific design characteristics of the turbines at the Wilder, Bellows Falls and Vernon projects to estimate potential entrainment rates and mortality of resident and diadromous fishes of interest. During the May 23, 2013 study plan meeting, the Service voiced concern over using this methodology…[additional reasons for concern stated]…While the Service does not object to using a desktop methodology to estimate turbine mortality at the three projects for resident fishes, we had recommended at the May 23, 2013 meeting that the results of the empirical mortality studies to be conducted on juvenile shad and adult eels be compared to estimates derived using the Franke et al. model. This comparison should allow further insight into the appropriateness of using a model, an off-site empirical study, or a site- specific empirical study to	Study plan revisions reflect stakeholder consultation meetings and discussions held during the 3-month comment period.

	estimate turbine mortality at a project. In the updated PSP, TransCanada has adopted this recommendation… [Table included in comments summarizing pertinent turbine specifications for projects where survival studies have been conducted on Francis turbines along with information from Vernon and Wilder].	
NHFG	This is just a desktop exercise and no field work is proposed. The study is supposed to "help establish a baseline condition to assist in evaluating the number of fish entrained or impinged and the expected survival of those fish at each of the projects." Without knowing actual numbers impinged or entrained, it is impossible to calculate the above. Baseline data on entrainment rates are site specific and should not be calculated by using data from studies at other dams and assuming things are the same.	The study plan has been revised to clarify the study objectives which are to assess the potential for impingement and entrainment and to estimate survival rates. This study is not intended to quantify the contribution of project-related mortality to a calculated population estimate for individuals of a specific fish species, but rather, to provide a qualitative assessment of the potential for impingement or entrainment. Desktop impingement and entrainment assessments of hydroelectric projects are routinely performed and are a widely accepted technique for the assessment of impingement, entrainment and turbine survival as part of FERC relicensing.
VANR	The objectives of the study will be accomplished through desktop analysis, not through field study as requested by other entities. As stated in the project nexus, this study will provide data to establish a baseline condition to assist in evaluating entrainment and impingement potential and the expected survival of those fish at each of the projects. However, the Agency feels that a desktop analysis alone would not provide the information needed to calculate the above. The Agency requests that in addition to the desktop analysis, estimates be ground-truthed by obtaining a sub-set of the actual numbers impinged or entrained. This would insure the study results would be more conclusive.	TransCanada respectfully disagrees with the need to collect field data for the purpose of assessing impingement and entrainment potential at the projects. Review of site-specific intake configurations coupled with a detailed review of species-specific life history and swim ability information is adequate to generate a qualitative assessment of entrainment potential. Survival estimates will be both estimated (using EPRI's data set) and calculated (using Franke et al. 1997) and will be validated through comparison with observed turbine survival for juvenile shad and adult eels. Desktop impingement and entrainment assessments of hydroelectric projects are routinely performed and are a widely accepted technique for the assessment of impingement, entrainment and turbine survival as part of FERC relicensing.

Study 24 – Dwarf Wedgemussel and Co-Occurring Mussel Study

Commenter	Comment	Response
FWS	The updated PSP for DWM has further clarified study methods and analyses to address the issues that were discussed that the study plan meeting on June 6, 2013. While it is understood that methodologies to answer the question of the projects' impacts on DWM are somewhat experimental, the updated PSP does a good job of laying out the sequence of data collection and consultation on next steps and study alternatives.	The revised study plan reflects stakeholder consultation meetings and discussions held during the 3-month comment period.
TNC	Study Goals and Objectives: Throughout this study, there is reference made to collaboration with resource agencies with regard to study design and implementation. We hope that this collaboration can include other members of the aquatics working group that have experience and expertise in study design and interest in the long-term success and persistence of dwarf wedgemussel (DWM) populations. The Nature Conservancy is certainly interested in the development of this study, and would like to be included if possible.	The study plan has been revised to replace applicable references to “resource agencies” or “agencies” with “aquatics working group”.
TNC	Deliverables: We request that a version of the results and report be made available that has sensitive information redacted. Currently, the language states that all of the results from Tasks 2 and the pilot study will be confidential. However, shell condition, abundance of uncommon species, habitat variables, observed behavioral response, and other valuable information will be provided in these reports. This information is important for understanding project effects, and should be made available apart from sensitive locality data.	The study plan has been revised to clarify that the reports made available to the general public will have sensitive information redacted. We have also clarified that members of the aquatic working group will have access to the full phase 1 study reports so that informed decisions can be made regarding the specific elements that will be included in phase 2 of this study. All persons in the aquatic working group will be asked to sign a confidentiality agreement to protect sensitive information.

Study 25 – Dragonfly and Damselfly Inventory and Assessment

Commenter	Comment	Response
NHFG	Given the rarity of the focal species that really should be considered SGCN (Gomphus quadricolor and Gomphus ventricosus) I'm not sure the proposed methods will be that productive in getting a better feel for their distribution and behavior - and thus inform conservation actions. Because emerging riverine Odonata can be highly variable in space and time, the proposed sampling scheme is not likely [to] fully capture the broader patterns, especially for rare species. By sampling only three times over the summer, it is quite possible to completely miss the peak emergence events for some species, thus limiting the amount of data that can be collected. Similarly, random survey transects perpendicular to the shore will easily miss clusters of exuviae/emerging adults that could be only a few meters away. In combination with a reduced temporal sample, there is a reasonable chance that no exuviae of some focal species would be found at a given site on a given visit, depending on the number of transects (which is not stated in the proposal). A better approach would likely be a survey plot covering several meters of shoreline, and still extending up the bank so as to measure emergence distances. I believe this is the method used by Morrison and colleagues during their studies on the river in Massachusetts. The other species listed by VT as being SCGN are not considered so in NH due to the results of the NH Dragonfly Survey. We can supply the application with the report of that Survey and some of the data if they would like it.	The study plan has been revised to include an additional site below Vernon Dam. A wide range of habitats, many of which include known Gomphidae sites, will be surveyed. This approach overlaps with Hunt et al. and should represent the diversity of habitats and most species in the approximate 120-mile study area. The study plan has been revised to clarify that we will coordinate sampling with low flow periods where feasible, although suitable weather may take precedence. Time and water levels will be noted at every sampling station. The methods for this odonate survey were based in part on those used by Hunt et al. 2010 and Morrison et al. 2006. While Morrison et al sampled a relatively small area intensively (twice weekly from early June to early August), Hunt et al sampled widely, with the sampling intensity ranging from once per year to 4 times per year. Our approach of sampling three times from mid-June to early August should provide a representative estimate of species, diversity and distribution of all riverine odonates. Spatially, the study plan includes 5 transects, each 3 m wide oriented perpendicular to the shoreline. Spread across the 100-m sampling site, these transects will provide a semi-quantitative, representative sample area of that shoreline. The methods section of the study plan has been revised to clarify these points.
VANR	The Agency requested a study on the effects of water level fluctuations from project operations on odonate	The study plan has been revised to clarify that we will coordinate sampling with low flow periods where

Commenter	Comment	Response
	species of greatest conservation need. The licensee's proposed study plan does not indicate at what water level the field surveys will be conducted. The Agency request that field surveys be standardized to the extent possible as the level of the impoundment or generation flows could greatly affect the survey. The Agency recommends that the impoundment elevation or project flows be recorded at the beginning and end of the each survey. Additionally the study plan should be clarified to indicate that height or elevation of each alarvae, tenerals, and exuviae found will correspond to the impoundment operation elevations.	feasible, although suitable weather may take precedence. Time and water levels will be noted at every sampling station.

Study 26 – Cobblestone and Puritan Tiger Beetle Survey

Commenter	Comment	Response
NHFG	The Puritan Tiger Beetle is also listed as endangered in NH. This should be noted and the permit request to NHFG should include that species. The goals listed from the VT Wildlife Action Plan are similar to that in the NH Wildlife Action Plan. The study area should include Johnson, Burnaps, Chase and Walpole Islands as well as any identified during their habitat assessment.	The study plan has been revised to specify the Puritan Tiger beetle as endangered in New Hampshire and threatened in Vermont and fedearlly. Sampling will include sites where the beetles have been recorded in the past, and where habitat appears suitable, including Johnson, Burnaps, Chase and Walpole Islands.

Study 27 – Floodplain, Wetland, Riparian and Littoral Vegetation Habitats Study

Commenter	Comment	Response
CRJC	Amend Terrestrial Study Plan #27 to identify the locations of reference sites in high quality wetlands, within and outside of the zone of influence of the project, which can be delineated and monitored for changes in species richness to assess whether wetlands are being degraded by project operations.	We consider this amendment to be a request for an expanded study which does not address the ILP study criteria. A comparison between wetlands within and outside of the project influences would not result in a reasonable determination of project effects since there could be a host of other factors beyond project operations that are the primary influences on either of the wetlands being compared. Therefore, TransCanada does not believe this request adequately meets ILP Study Criterion 5 as the results of this monitoring would not inform the development of license requirements in a new license. There is no need for this additional study scope and the information it would provide (ILP Study Criterion 4). However, within the study plan, wetlands that are hydraulically connected to project operations wetlands will be identified and mapped within the study area and additional field data collection will be conducted, including in high quality wetlands within the study area.
CRWC	The study should not stop at the face of the Vernon Dam. All study plans should clearly identify an agreed upon location where one applicant's responsibility ends and the other start so there will be no reach of the river that is not surveyed.	The study plan has been revised to include in the study area, shorelines extending to a point approximately 1.5 miles below Vernon dam, including shorelines on Stebbins Island.
CRWC	TC should make available to the Natural Heritage Programs of VT and NH all information about all RT&E species and habitats. Stakeholders should have access to the overall results about the identification of RT&E species with any sensitive location information redacted.	TransCanada has made available to the states all RT&E data from the 2012 study and will do so for this study, in accordance with state requirements for confidentiality. Study reports will include a "public" version that withholds confidential information and a "confidential" version provided to the states. If

Commenter	Comment	Response
		stakeholders feel there is a need for access to sensitive information to facilitate informed decisions, we suggest they contact the appropriate state or federal agencies to request a copy of the information through non-disclosure or confidentiality agreements.
FWS	Methods: Invasive Plant Species- At the June 6, 2013 study plan meeting, the Service questioned whether the entire shoreline would be mapped for invasive species. In response, TransCanada noted that during the 2010 erosion survey, invasives data were collected. Service staff stated that, based on the level of detail presented in the Pre-Application Document, it was unclear what types of invasives data were collected in 2010 (were dominant species identified? did the geo-spatial documentation allow for a quantification of infestation?). In response to these concerns, TransCanada has updated the plan to specify that well-defined beds of invasives would be revisited, mapped with GPS, and characterized. The Service supports these changes, as it will allow for a more informative assessment of invasives throughout the project-affected areas.	Study plan revisions reflect stakeholder consultation meetings and discussions held during 3-month comment period.
FWS	Analysis: For the bald eagle information, we recommend that the report provide maps of the project area showing locations of all eagle roosting and nesting trees. A complementary table should be provided listing the location of the trees, whether it is a roosting or nesting site, an assessment of its status (healthy, diseased, etc.) and its level of protection (e.g., within a right-of-way, on protected/conservation land, etc.).	The study plan has been revised to specify that TransCanada will rely on the TC-sponsored on-going bald eagle breeding season studies by Audubon Society of NH to provide nest tree locations and condition. In this study, the location of the trees and level of protection will be depicted in a confidential section of the report. Few data exist on winter roosting sites along the river. The study plan has been revised to include a baseline habitat assessment using aerial photography to identify potentially suitable winter roost habitat.
City of Lebanon	In 2012, TransCanada commissioned a Rare, Threatened and Endangered Plant Species Study conducted in 2012 by Normandeau Associates. A	The “mist community” per se is not a recognized rare community, but the areas below all 3 dams were searched during TransCanada’s 2012 rare species

Commenter	Comment	Response
	"public" copy of this report, which does not include location of sensitive sites, was only recently made available on the FERC website for review. It was noted that a number rare/unusual habitats, similar to the mist community, had been identified already by Normandeau, the project consultants. Comments from the City's NRI Consultant, Dr. Rick Van de Poll, were included in the transcript and noted by the Normandeau's consultant Sarah Allen.	survey. Any rare species populations found were documented and provided to the Natural Heritage Bureaus of Vermont and New Hampshire.
NHDES	p. 260, Methods and p. 64, Deliverables. NHDES requests that the study plan 1) indicate use of field GPS units (with accuracy specified) for mapping, 2) that data will be uploaded and annotated in GIS so that plant species and their distribution are all geo-referenced, and 3) that the shapefiles generated from the field work will be shared with resource agencies such as NHDES.	The study plan has been revised to indicate that locations of representative habitats will be ground-verified using sub-meter GPS. The final GIS maps will include cover types for all communities. Site specific data will be limited to the representative habitats and will be provided in the report.

Study 28 – Fowler's Toad Survey

Commenter	Comment	Response
VANR	The Agency study request for the Fowler's toad survey recommended that the study include wet road searches and wildlife acoustic recorder to increase the likelihood of detecting toads. TransCanada study proposal does not include the use of wet road searches and only will use wildlife acoustic recorders depending on the habitat available. The Agency request that TransCanada use wet road surveys because it allows you to find Fowler's Toads outside of their brief breeding period and away from the breeding pools. This will greatly expand your time- search window and allows you to find toads in their terrestrial habitat away from breeding pools and may provide useful information that would lead to the discovery of	TransCanada respectfully disagrees. It would be disproportionately expensive to perform wet road surveys for this project since it would require sending biologists out on multiple rainy nights to survey multiple small roads for the toad. Wet road surveys may or may not yield Fowler's toads and while such surveys may provide insight into the direction of travel for Fowlers and thus indirectly, non-breeding habitat, the additional information gained does not balance the additional cost. The methods proposed in this study focus on breeding areas because of the relative high likelihood of locating singing males. The effort and expense to conduct wet road surveys will yield relatively limited additional data

Commenter	Comment	Response
	alternative or unexpected breeding and foraging habitat within the project boundary. Small roads within the floodplain and within a mile of the river could be targeted.	given the size of the study area, therefore is not proposed in this study plan. TransCanada will regularly contact VANR for reports of additional Fowler's toad observations throughout the field study period. TransCanada does not believe this study scope expansion is warranted due to the additional effort and cost for what we believe to be the benefits to assessing project effects. As a stand-alone element, we do not believe it meets ILP Study Criterion 7.
VANR	Additionally, the Agency continues to recommend that TransCanada use wildlife acoustic recorders. Using acoustic wildlife recorders would allow for continual gathering of call data from a handful of the most promising locales without requiring the presence of observers, increasing the likelihood of detection of breeding sites during the brief breeding period. Furthermore, predicting when weather conditions will be right for breeding is difficult, therefore relying on the three call surveys conducted in late May through July will not be adequate and using the acoustic wildlife recorders would increase the likelihood of detection.	The study plan has been revised to state that: "Based on the results of the mapping and preliminary surveys, up to 5 wildlife acoustic recorders (FrogLoggers is one brand) will be placed at the locations historically known to be occupied by, or potentially suitable for this species"

Study 29 – Northeastern Bulrush Survey

No written comments were received.

Study 30 – Recreation Facility Inventory and Use & Needs Assessment

Note: Comments received from New England Flow and the combined comment letter from Appalachian Mountain Club/ Vermont River Conservancy/and Friends of the CT River Paddler's Trail were virtually identical. Their comments are identified below in the commenter column as "NEF and AMC-CRV-FRs."

Commenter	Comment	Response
American Whitewater	The licensee intends to draw on information gathered from public recreation area visitors, residents from neighboring communities and less common user groups including, allegedly, whitewater boaters. The licensee's proposed methodology for collecting this data, however, does not propose any meaningful effort to survey whitewater boaters who would be best able to provide the licensee with useful information that would allow it to achieve its study objective.	TransCanada respectfully disagrees with this statement. We expect to receive meaningful information from all types of recreational visitors and potential visitors from the methods proposed in the study plan. We also expect to gain very relevant information from whitewater boaters during all phases of Study 31 - Whitewater Boating Flow Assessment.
American Whitewater	The licensee's proposal to collect data from recreational area visitors will exclude virtually all users that are interested in whitewater boating because there are no whitewater boating opportunities at Bellows Falls due to the lack of water in the natural bypassed reach on any predictable, sufficient and consistent basis, and, due to the presence of certain impediments constructed by the licensee in the natural bypassed reach. At Vernon, there are no whitewater boaters because there are no whitewater boating opportunities due to the presence of the dam that has downed any potential boating opportunities there. At Sumner Falls/Hartland Rapids, there are fewer whitewater boaters because of the lack of predictable, sufficient and consistent flows. Surveying visitors at these locations will not yield meaningful data on the extent of the public's interest in whitewater boating because individuals interested in these activities are absent from the area because the licensee's operations have made whitewater boating difficult if not impossible in the project area.	We expect to obtain some interview data at Sumner Falls/Hartland Rapids during scheduled visits; however the bulk of relevant information on this site directly related to whitewater boating interests will be obtained through the methods detailed in Study 31 – Whitewater Boating Flow Assessment, which was developed to specifically characterize the boating resources including user preferences at the site. At this time, studies specific to the Bellows Falls bypassed reach will concentrate on the suitability for whitewater boating in this area.

Commenter	Comment	Response
American Whitewater	The licensee's proposal to randomly survey 2400 residents of neighboring counties will fail to target a sufficient number of whitewater boaters to draw any meaningful conclusions about the demand for whitewater boating at these sites or the adequacy of existing facilities. The licensee has no plans to survey users at other locations such as the West or Contoocook rivers, no plans to collect data from whitewater outfitters, no plans to work with organizations such as American Whitewater, New England FLOW, or the Appalachian Mountain Club to survey their members, no plans to develop [an] internet-based survey of whitewater boaters, and no plans to conduct any focus groups to determine the extent of interest in boating in the project area.	Whitewater boating currently exists at Sumner Falls and general information about this opportunity is detailed on American Whitewater's web page. We will be performing intercept interviews soliciting input from boaters at the Sumner Falls rapid which, in combination with Study 31 –Whitewater Boating Flow Assessment, will yield valuable information on characterizing whitewater boating related to the project. Study 31 has been developed for this purpose. The Bellows Falls bypassed reach is also included in Study 31 to investigate the feasibility of whitewater boating in this area. The results from that study will present meaningful conclusions about demand for whitewater boating at known or potentially interesting sites influenced by the projects. The purpose of the randomly mailed survey is to extend the sampling effort beyond the reach of the interviews and spot counts to potentially capture users that recreate during other times of day or year (e.g., night fishing, hunting, ice fishing). In addition, the mailed survey will provide data on reasons that respondents give for visiting or not visiting the project areas for all types of recreational purposes. This data will help to inform what types of recreational enhancements may be appropriate or valued at each project, including those that may be related to whitewater boating. This information will be supplemented with Statewide Comprehensive Outdoor Recreation Plan (SCORP) information and boater guides for the regional/landscape scale context in which these resources exist. We respectfully disagree that we do not have plans to work with American Whitewater and New England FLOW as these entities will play important roles during Study 31 and will consult with them after the study

Commenter	Comment	Response
		plan is approved. Study 31 will utilize a focus group type approach. With regard to the suggestion for focus groups, we believe that this study will capture user interests through interviews and mail surveys without the need for focus groups. Focus groups are included in Study 31 specifically related to whitewater boating.
American Whitewater	While the licensee proposes to conduct user counts and maintains that this data will provide it with information on the recreation use at the project, this data will provide no information on the non-use of the project by whitewater boaters who cannot access the recreational opportunities due to the inadequacy of the facilities or the manner in which the licensee operates the project. The licensee simply ignores the request by FERC that it collect data on unique stakeholder groups such as whitewater boaters. Nothing in the licensee's study plan is designed to collect data on demand by non-users, including whitewater boaters and through paddlers, and licensee makes no attempt to identify the perceived adequacy of its facilities by these user groups… [The proposed surveys and questionnaires] will not, however, show the extent of the demand for these activities by those who go elsewhere due to the inadequacy of the recreational facilities to support these activities in the project area, such as the lack of water in the natural bypassed reach.	We respectfully disagree. The revised study plan assesses typical and atypical use through the spot count forms/surveys conducted at recreation areas including the known boating at Sumner Falls. Study 31 – Whitewater Boating Flow Assessment will assess the existing boating resources in detail as well as the feasibility of boating in the Bellows Falls bypassed reach. The potential, uncommon, and non-visitor questionnaire will develop data on why potential visitors do not take advantage of recreational opportunities in the project areas. This information will be supplemented with Statewide Comprehensive Outdoor Recreation Plan (SCORP) information and boater guides for the regional/landscape scale context in which these resources exist.
CRWC	The study plan should identify an agreed upon location, agreed between TC and 1st Light where one applicant's responsibility ends and the other's starts [below Vernon dam] so there will be no reach of the river that is not surveyed.	The revised plan describes Study Areas and Study Sites as including the "Wilder, Bellows Falls, and Vernon Projects (lands and waters)…" Specifically, the study area includes the project impoundments within the project boundaries and existing formal and informal public recreation areas including TransCanada access areas, state and municipal lands and access areas, and commercial recreation areas (marinas) located adjacent to the projects that provide water and

Commenter	Comment	Response
		land based recreation opportunities for the general public. Table 30-1 of the revised study plan includes the Stebbins Island Canoe Rest Area, which is downstream of the recreation areas immediately below Vernon dam but within the project boundary, as the most downstream site included in the recreation facility inventory.
CRWC	TC should invest some level of effort in surveying winter river users during the winter, especially ice fishers.	The study plan has been revised to include field visits in January, February, March and April to capture off-season uses. These visits will include maintaining traffic counters through the winter and collecting spot count and interview data. In addition, the intercept survey (Attachment 30-D) and mail-back survey (Attachment 30-E) have been revised to include questions that ask visitors to report on use and activities during other seasons.
CRWC	Whitewater river users are limited to one location in the project reach of the river, the one at Sumner Falls in Hartland, VT. The survey work there will be of value but more people probably paddle the USACE releases from the Ball Mountain and Townshend dams when they occur then you will ever run into at Sumner Falls. TC should survey, at least once, some number of the participants present during the release at USACE flood control dams on the West River.	Although whitewater boater use of releases from USACE flood control dams can provide whitewater opportunities, it would be difficult to relate information obtained from those users to boating opportunities in project affected waters. Information gleaned from this study will be supplemented with Statewide Comprehensive Outdoor Recreation Plan (SCORP) information and boater guides for the regional/landscape scale context in which these resources exist.
CRWC	TC should contact canoe, rowing and other non-powerboat groups including those who sell people powered vessels and ask for their input about what attracts them to or keeps them away from the river.	The study plan includes the uncommon or potential visitor questionnaire (Attachment 30-E) which will capture the potential user groups mentioned. The proposed survey includes questions related to why people recreate or not at the projects and in the riverine sections between projects.
CRWC	The survey should test the public's knowledge and use of the visitor centers at the dams including what would make them more attractive as focal points for information about the health and uses of the river.	The Bellows Falls Visitor's Center and fish ladder, and the Wilder and Vernon publicly-accessible portions of the fish ladders are already included as sites that will be visited under the site inventory, interviews, and

Commenter	Comment	Response
		spot count methods associated with characterizing recreational use at the project. Potential interviewees at these locations will have the opportunity to respond to the proposed survey (Attachment 30-D).
CRWC	The recreation study plan and survey forms should include information on specifically whether or not access points meet ADA standards.	The revised Recreation Facility Inventory Form (Attachment 30-A) contains a specific entry for the number of ADA designated parking spaces and additional barrier free assessments will be included in the “Notes” portion of the form.
CRWC	TC should evaluate all three of the portage paths around the dams in conjunction with canoe and other river user groups to increase user safety and portage reliability.	The study plan has been revised to include an assessment of potential alternative portage routes around all three dams.
City of Lebanon	All recreation facilities along the River will be included in the Study Plan rather than just those within the defined project areas. The City's riverfront municipal conservation areas at Chambers, Cole, and Two Rivers will be included, as well as New Hampshire Fish and Game's Trues/Blood Brook cartop boat launch. Westboro and River Park, both potential recreation facilities, will likely come under the section of the study pertaining to future needs. Maintenance of existing facilities and inclusion of interpretive/educational materials at the Wilder Dam Picnic Area and portage trail will be included in the first phase of the Recreation & Aesthetics study, which includes obtaining information regarding the condition and use of existing recreation facilities and public viewing areas.	Table 30-1 of the revised study plan includes existing facilities to be included in the existing facility inventory. With regard to the potential recreation facilities planned for Westboro and River Park, we will reach out to the City of Lebanon and use appropriate information in the study report as it pertains to recreation access. The revised plan and facility inventory form include observations of facility maintenance and interpretive/educational signage.
NEF and AMC-CRV-FRs	We feel a wider range of facilities and options should be considered for the inventory assessment. As one example, if a concrete boat ramp is present at a put-in; most inventories simply indicate a ramp.	The inventory form included in the revised study plan includes an entry for “suitability for hand launching.” This is intended to address the sensitivities related to concrete ramps that could damage certain types of hand launched boats. The study plan has been revised to make this clear.

Commenter	Comment	Response
NEF and AMC-CRV-FRs	We suggested surveying a wider group of users and especially of non-users of the TransCanada facilities. While some of this is planned, we encourage TransCanada to expand this survey of non-users. Such surveys can be more cost effective and cover a wider audience by including mailing lists of NGOs, such as the FLOW, American Whitewater and the Appalachian Mountain Club, which collectively can provide thousands of relevant survey contacts in the region. The only bias in these groups is an interest in the outdoors and water-based recreation.	The target of the revised study plan's "Potential Visitor Questionnaire" (Attachment 30-E) includes non-users. The purpose of the randomly mailed survey is to provide data on reasons that respondents give for visiting or not visiting the project areas for all recreational purposes. The questionnaire will be mailed to 2,400 households in the region. This data will help to inform what types of recreational enhancements may be appropriate at each project, including those that may be related to whitewater boating which is also the subject of Study 31 – Whitewater Boating Flow Assessment.
NEF and AMC-CRV-FRs	We suggest that TransCanada engage in a broader range of survey techniques that produce more qualitative results and greater accuracy, such as focus group interviews.	The revised study plan includes provisions to intercept recreation users on site and ask them to complete surveys (included in the revised study plan Attachment 30-D) which include open ended questions that will provide qualitative results. This methodology is employed across the country in the majority of FERC relicensing proceedings. Study 31 - Whitewater Boating Flow Assessment and Study 32 – Bellows Falls Aesthetics Flow propose to utilize a focus group type approach. Taken together, the recreation and whitewater studies employ a broad range of techniques.
NEF and AMC-CRV-FRs	We are concerned about projecting future uses of the river using national models. Predictions of the future are always speculative, and using "standard sources" emphasizes regression to the mean rather than providing any useful information. FLOW agrees with Adam Beeco from FERC that more updated literature on doing future research is needed for this study.	TransCanada has researched and identified the most up-to-date literature on predictions of future use where available, and we have used and cited those sources to revise the study plan. Our approach to projecting future use is consistent with the updated literature.
NEF and AMC-CRV-FRs	We have questions about the standards employed to assess the sites already on the river. How is overcrowding measured, or even determined? Exactly what facilities would one expect to find at different kinds of campgrounds? We recommend looking at the extensive work done by the Connecticut River	Overcrowding is typically determined during spot counts at recreation sites; if existing parking facilities are full and evidence of parking off-site is found, it suggests capacity is being exceeded and overcrowding is an issue. The purpose of the site inventory is to define the types of facilities at existing campgrounds,

Commenter	Comment	Response
	Paddlers' Trail to define what constitutes adequate campground frequency and equipment.	not make judgments about what types of facilities would be expected at any facility. We will include relevant information from the Connecticut River Paddlers Trail and Connecticut River Boating Guides (which were referenced in the project PADs) in the study report.
NEF and AMC-CRV-FRs	The portage trail around the Bellows Falls Project is abysmal. The improvement of the portage may come under any number of studies, including #30, #31, #32, and #33. The portage at the Wilder Dam is nearly as bad, and an alternate route on the other side of the river has been suggested. The portage at the Vernon Dam also has issues.	The study plan has been revised to include an assessment of the potential for alternative portage routes around all three dams.
NHFG	Survey should cover all seasons as the public uses the river and its recreation facilities throughout the year. Study plan should include the following: 1) provide a maintenance schedule for the upcoming license period for all TransCanada recreation sites, 2). Add another question to on site interviews that ask if impoundment fluctuations have ever impacted their recreation (not just if fluctuations impacted their recreation on day of interview.	The revised study plan's intercept survey and mail-back survey (Attachments 30-D and 30-E) include questions that address public uses during all seasons. In addition, the study plan has been revised to include field sampling in January, February, March and April. The revised study plan's recreation facility inventory form (Attachment 30-A) includes an entry for the maintenance of recreational facilities. Maintenance schedules of TransCanada facilities will be summarized in the study report/ We prefer to restrict the respondents input to their experiences on the day of the interview, rather than opening it up to the ambiguous question of whether impoundment fluctuations ever affected their recreation experience. Any reported experiences would have to correspond to a date and time that could be verified in order to determine if the event was related to project operations or was a natural event to fully understand the nature of their reported experience.

Commenter	Comment	Response
NPS	Numerous RAs and NGO noted that this study would be considerably improved if it were to capture non-users, including those who may have used project related facilities in the past and no longer do so and those potential users who for various reasons, do not utilize project area facilities. Several methods for capturing those users and their input were identified. In brief, the NPS believes it would be simple, cost effective and produce useful data if the applicant were to avail themselves of the MA, VT and NH members of organizations such as the Appalachian Mountain Club (AMC), whose members would logically have an interest in recreating on the Connecticut River. The AMC has graciously offered to work with the applicant to transmit updated survey questionnaires to their membership in the project area. AMC has also developed a recreation plan for the Connecticut River Blueway, referenced above.	The objective of this study is to obtain information that accurately characterizes the locations and types of recreation access, the condition of those facilities, the amount and types of uses at the projects or potentially affected by project operations, existing capacity of the facilities, and the perceptions and opinions of users of those facilities. We recognize that some user groups may not be captured during the intercept survey and as such, the revised study plan's Potential Visitor Questionnaire (Attachment 30-E) will also capture non-users. In addition to supplementing information on potential user groups, the mailed survey will provide data on reasons that respondents give for visiting or not visiting the project areas. This data will supplement the other survey tools. Our approach eliminates potential bias from sending surveys to a single group (which may or may not have any greater reason to recreate in the project areas than other users not affiliated with an organization) and this approach is consistent with generally accepted scientific practices and other FERC relicensing proceedings. We will include a review of AMC's recreation plan for the Connecticut River Blueway in our broader review of management plans as indicated in the study plan.
NPS	Extensive work has been done by the Friends of the CT River Paddlers Trail relative to river access campsites in terms of appropriate frequency (how far apart on the river) as well as maintenance and facility needs. Efforts are underway to expand the trail into Massachusetts and Connecticut. This data should be incorporated into the study in order to identify obstacles to multi-day paddling trips, which also include the lack of adequate or existing portages around project dams.	We will review The CT River Paddlers Trail maps and literature as well as the CT River Boating Guide and use appropriate information in the study report as it pertains to characterizing through paddlers. In addition, the study plan has been revised to include field visits to the river access campsites to measure the levels of use (spot counts) and administer intercept interviews to this user group.
NPS	Additional information and resources were identified in the PSP meetings and should be utilized to refine the	A purpose of this study is to identify existing river oriented recreation sites, and we incorporated those

Commenter	Comment	Response
	study. These include City of Hanover owned conservation lands abutting the impoundment just south of the Hanover town line, numerous developed trails with no river access, a proposed public access south of the Westborough River which is awaiting the completion of a bridge project on long term hold, Two Rivers Park Natural Area (Mascoma River confluence below Wilder) includes developed trails, and sites approved for recreational activity, but as yet inbuilt… In addition, an area developer who attended the meetings noted that he has offered to allow access on a 15 acre part of his site as well as adjacent lands suitable for trails.	existing sites into the revised study plan to be assessed in the recreation site inventory. For existing sites with no access to the river or for proposed but not yet built recreation sites, TransCanada will assess if there is a nexus to any of the three projects, prior to considering if such sites represent potential recreational enhancement opportunities.
NPS	The revised study should include a comprehensive assessment of the condition of each site, along with how various ratings (good, fair or poor) are defined and applied. As noted during the meetings, there are situations where the presence of a boat ramp may actually limit access for certain kinds of users. Concrete ramps may be unsuitable for hand carried boats, where sites with a small floating dock can allow these users to access the river.	Attachment 30-B of the revised study plan is the site condition and visitor use form which defines how site condition is defined and how it would be applied. The inventory form includes an entry for "suitability for hand launching." This is intended to address the sensitivities related to concrete ramps that could damage certain types of hand launched boats. The study plan has been revised to make this clear.
NPS	The revised study should extend the time it is to be conducted beyond Sept 30, allowing it to capture users in the fall and winter seasons which may well account for significant use. The survey also does not account for use by minors; however, by utilizing AMC data, for instance, those users will be identified through family membership data. The revised study should also include a method to reach school groups. Although the towns may or may not have that data, queries should be put to area schools to ID which of them go on field trips and equally important, why they may not visit river based recreational facilities nearby.	The study plan has been revised to extend the intercept and spot count survey period to October 15 which will cover the bulk of the fall recreation season. The limiting factor regarding recreation use during the winter is whether or not access points are available to recreational visitors. We consider it appropriate to identify those access points that are not available during the winter (e.g., gated, not plowed, etc.) and capture some of that information during the desktop and inventory phases of the study. We recognize that some areas may be more popular than others for off-season recreation (e.g., areas that freeze) or may be restricted by site closures. To accurately capture the nature of off-season access and

Commenter	Comment	Response
	Additionally, the study data collection phase should extend to two years to allow for vagaries in weather and economic conditions which change from year to year. A single field season may provide good data, but a second year is certainly preferable. The field surveys should also extend to ½ hour before sunrise and ½ hour after sunset. The current proposal to start them ½ hour after sunrise and end ½ hour before sunset will miss many if not most anglers who tend to put in before sunrise and/or may take out after sunset.	demand for some of the sites the study plan has been revised to include a limited amount of field visits to document use during the off-season. Interviews and spot counts will be conducted during these visits. We expect many of the recreational visitors during the winter to also recreate in the project areas during the summer, and our intercept questionnaire includes questions that address winter recreational use in the project area. The intercept interview form will be administered to those 16 years and older, but members in their group that are younger than 16 will still be accounted for in the form. The primary project-influenced destinations for school groups would likely be the Bellows Falls Visitor Center and fish ladders at each project which are included in the revised plan. The presence of schools groups as a visitor type has been noted in the revised study plan, and at a minimum, will be captured in the spot count form. We will coordinate with our community relations specialist to identify how many school groups have recently contacted us for information related to the projects. The study plan calls for a one year study completed in 2014. TransCanada does not propose to conduct additional studies in 2015. The start and stop times for the survey (1 hour after sunrise and before sunset) are designed to capture those anglers who put in before sunrise and take out after sunset as the survey clerks would be in the field at the same time those anglers would be actively recreating. Interviewing an angler after they have already started fishing in the morning and they start to formulate opinions about their experiences that day is preferable to interviewing them before their trip starts

Commenter	Comment	Response
		and they haven't started recreating yet.
NPS	The adequacy of the portages at each dam must also be addressed in order to cure existing deficiencies in the opportunities for multi-day paddling trips. Bellows Falls is currently the most problematic of the three, but all need to be adequately addressed.	The study plan has been revised to include an assessment of alternative portage routes around all three dams.
VANR	TransCanada's proposed study plan includes an inventory at recreational facilities currently available to users to evaluate the site conditions and ability to meet the recreational demand, and to identify any impediments to recreational users. Additionally, TransCanada is proposing to conduct recreational user surveys and site inventory evaluations between May 1 and September 30 with survey of users ending around October 15. The Agency concern is that by ending the study at the end of September the study will not include any comments from the winter recreationalist that ice fish, cross country skiing, snowshoe, or snowmobile. Furthermore, the site evaluation form should indicate if the recreational facility is maintained on a regular basis in the winter months, as a major impediment to winter recreationalist could be lack of access to unplowed facilities.	We consider it appropriate to identify those access points that are not available during the winter (e.g., gated, not plowed, etc.). During the desktop and inventory phases of the study we will characterize the sites that close or may be closed during the winter months. The study plan has been revised to maintain traffic counters year round and to include limited off-season sampling to confirm the availability of access, the amount of use at those access points, and to conduct interviews and spot counts. We also expect many of the recreational visitors during the winter also recreate in the project areas during the summer, and our intercept questionnaire includes questions that address winter recreational use in the project area.
VANR	Attachment 30-D: On-Site Intercept Survey - Question 17: The Agency request that TransCanada include winter activities such as ice fishing, snowmobiling, cross country skiing, and snowshoeing in the list of activities.	The study plan has been revised to reflect these suggestions.
VANR	Attachment 30-D: On-Site Intercept Survey – Question 24: The Agency requests that TransCanada modify or include an additional question that ask the recreationalist if their recreational experience had ever been effected by fluctuation in water levels at either the Wilder, Bellows Falls, or Vernon reservoirs or downstream of the projects.	We prefer to restrict the respondents input to their experiences on the day of the interview, rather than opening it up to the ambiguous question of whether impoundment fluctuations ever affected their recreation experience. Any reported experiences would have to correspond to a date and time that could be verified so as to identify if the event was related to TransCanada hydro operations or was a natural event to fully understand the nature of their

Commenter	Comment	Response
		reported experience.
VANR	Attachment 30-E: Potential Visitor Questionnaire: Section 1 Mail/Internet Survey – Question 6: This question request that a recreationalist select only the primary season (Winter, Spring, Summer, and Fall) which the person recreates on the Wilder, Bellows Falls, or Vernon reservoir or downstream of the projects. This question should be reworded so that a recreationalist can select any season that they recreate in the vicinity of the projects. The Agency's concern is that multi-seasonal recreationalist will not be captured in the survey.	The revised study plan's Attachment 30-E, the Potential Visitor Questionnaire, is designed to first ask about a respondents primary activities and primary season when they recreate within or downstream of the projects. The follow up questions ask the respondent to mark all activities and seasons so that the multi-season recreationist is captured.
VANR	Attachment 30-E: Potential Visitor Questionnaire: Section 2 Mail/Internet Survey – Question 24: The Agency request that TransCanada include winter activities such as ice fishing, snowmobiling, cross country skiing, and snowshoeing in the list of activities.	The study plan has been revised to include the suggested additions.

Study 31 – Whitewater Boating Flow Assessment – Bellows Falls and Sumner Falls

Note: Comments received from New England Flow and the combined comment letter from Appalachian Mountain Club/ Vermont River Conservancy/and Friends of the CT River Paddler's Trail were virtually identical. Their comments are identified below in the commenter column as "NEF and AMC-CRV-FRs."

Commenter	Comment	Response
American Whitewater	American Whitewater supports efforts by the licensee to study the potential for enhancing whitewater boating at Sumner Falls/Hartland Rapids as well as in the natural bypassed reach at Bellows Falls, and credits the licensee for utilizing the study techniques recommended by Whittaker et al., in "Flows and Recreation: A guide to studies for river professionals" (2005).	Study plan revisions reflect stakeholder consultation meetings and discussions held during the 3-month comment period.
American	We also acknowledge that the licensee has removed	We concur that it is premature to assess demand for

Commenter	Comment	Response
Whitewater	references to studying the demand for whitewater boating in Study 31; however, we remain concerned that the licensee intends to attempt to quantify demand without providing an adequate methodology for accomplishing this objective. To the extent that the licensee intends to incorporate demand for whitewater boating in this study, it needs to explain how it will accomplish this objective. A meaningful study of the demand for whitewater boating, if the licensee intends to study this issue, should include a survey of boaters on area rivers such as the West and Contoocook rivers, outreach on social media or message boards, internet-based surveys of paddlers, contacts with whitewater outfitters in the region, and outreach to organizations such as American Whitewater, New England FLOW, and the Appalachian Mountain Club to survey their members to determine their interest in whitewater boating in the project area. As such, a determination of demand for whitewater boating is premature at this point until the controlled flow study has been completed and optimal flows have been identified. Demand is only one consideration in determining whether predictable, consistent and suitable whitewater flows should be provided to Sumner Falls/Hartland Rapids and to the natural bypassed reach at Bellows Falls. Once a determination has been made that the natural bypassed reach is boatable at certain levels, FERC should require that the licensee provide scheduled releases in order to provide whitewater paddlers with the opportunity to enjoy this section of the river.	potential whitewater boating enhancements until the nature of the opportunity is defined. Defining the nature of any such opportunity is the goal of this study.
American Whitewater	The licensee further states in its proposed study plans that it intends to determine the number of days flows for whitewater boating are available under the projects' current operation at both locations. While the licensee can make this determination at Wilder once	As the commenter points out, if inflows to the Bellows Falls Project exceed the discharge capacity of the station, excess water must be spilled to the bypassed reach. How often and at what level this occurs under existing conditions can be readily assessed by utilizing

Commenter	Comment	Response
	optimal flows have been determined, it cannot make that determination at Bellows Falls. The current condition at Bellows Falls is that the licensee diverts approximately 40,000 cfs into the power canal for generation, spilling only “leakage” into the natural bypassed reach unless flows exceed its generating capacity. There is no flow in the natural bypassed reach at Bellows Falls on any consistent basis, and as a result, there is no basis for making this determination there. Instead, the licensee should examine the extent to which it is able to forego generation at Bellows Falls in order to provide boatable flows to the natural bypassed reach.	existing project operations data, including exceedance curves provided in the project PAD. Whether any such spill events represent whitewater boating opportunities is dependent on the results of this study. Until this study is completed, it is premature to consider foregoing generation to provide boatable flows to the bypassed reach.
American Whitewater	The licensee also raises the concern about the safety of boating in the bypass reach, citing instances of personal injury and accidents, including at least one fatality, due to public use or attempts at boating spill related flow in the bypassed reach. Safety has been a core issue for American Whitewater since 1954, and today we are leaders in accident analysis and safety education…American Whitewater maintains the most comprehensive accident database on whitewater boating, and regularly collects accident reports on injuries and fatalities resulting from whitewater flows [lists some in the CT river]…We are not aware of anyone having boated in the natural bypassed reach due to the near complete lack of access to this reach…Given that the licensee has no specific information regarding any incidents at Bellows Falls, it should base its study plan on known facts rather than presumed risks.	We are keenly aware of the dangers present in the Bellows Falls bypassed reach by virtue of observing and managing operations at this facility for many years. As the commenter points out, safety should be a concern to whitewater boating and will be a key element of the assessment of this reach. We look forward to tapping the expertise on boating safety from expert boating participants willing and able to provide such when the study takes place.
American Whitewater	The licensee proposes to assess the presence, quality, access, flow information, and flow ratings for paddling opportunities in a stepwise manner. Significantly, the licensee plans to identify and document and assess any insurmountable risks prior to committing to on-water flow reconnaissance or controlled flow	During the course of this study we intend to engage whitewater boaters in assessing whether there are insurmountable risks to on-water boaters. We have every intention of proceeding to the “boats on the water” step of this study (level 3 in the study plan) if practical and safe. Our proposed approach is not

Commenter	Comment	Response
	evaluations...While American Whitewater recognizes that circumstances may require changes to the controlled flow study, believe that the licensee should proceed to an on-water assessment unless the natural bypass reach is unboatable at any level.	inconsistent with this comment.
American Whitewater	The principal hazard in the natural bypass reach is the presence of the low-head dam that was presumably constructed by the licensee to prevent fish passage, likely by Atlantic Salmon, into the natural bypass reach instead of the fish ladder at the Bellows Falls Dam...The licensee should be required to investigate the ownership, history and purpose of the low-head dam as part of its effort to study the restoration of flows into the natural bypass reach. The ability of whitewater boaters to use the natural bypass reach a lower flows that are compatible with other recreational uses may well be enhanced by the removal or the breaking of the dam, and the licensee should investigate the feasibility of doing so as part of this and other studies.	As we stated during study plan meetings, removing the low-head dam in the bypassed reach is not planned during the ILP study phase. The bypassed reach will have to be assessed in two phases. Flow levels are also a very critical safety element as well. Consideration of the pros and cons of removing the dam, including methods of removal and permits required, may be more appropriate at a later time when the biological and recreational attributes of the bypassed reach under existing conditions have been defined.
NEF and AMC-CRV-FRs	The mechanisms of controlled-flow whitewater evaluations at sites such as Sumner Falls and Bellows Falls are widely known and have been used on many rivers. We believe the keys to successful evaluations include working together with NGOs to obtain the right mix of paddlers in the right mix of craft, having controlled flows that provide a good range of conditions, and using good evaluation survey forms with the boaters. Members of the New England FLOW, American Whitewater, and the Appalachian Mountain Club have participated in several successful controlled-flow studies during FERC relicensings.	The study plan has been revised to incorporate these concepts.
NEF and AMC-CRV-FRs	We appreciate that opportunities have been built into the [Bellows Falls] study for scouting and appraisal by expert boaters before the controlled-flow study begins. That should help us determine the appropriate size for evaluation flows, however all flows should be	The study plan has been revised to include provisions for identifying local boaters to participate in the controlled flow portion of the study (level 3).

Commenter	Comment	Response
	evaluated and include local boaters who have a range of experience on different rivers if an accurate assessment of flow is to be achieved.	
NEF and AMC-CRV-FRs	It is important that calculated flows in the bypass reach be accurate. The flows provided for evaluation should be measured exactly, rather than being estimated.	Calculated flows to the bypassed reach will be as accurate as possible based upon gate opening and flow equations. Gate settings will also be recorded besides flow calculations.
NEF and AMC-CRV-FRs	One unresolved issue is what to do about the low-head fish barrier dam near the bottom of the bypass reach. The FLOW, AW, and AMC favor removing the dam….Their consultants state they had been studying the dam under different natural flow conditions and they believe it is runnable. NE FLOW will want to take a close look at it and the boaters in the test runs will make their own decisions about that.	Whether the fish barrier dam is runnable and if so at what flow has not be determined or studied. At this time TransCanada does not intend to allow boaters to "run the barrier dam" under any circumstances.
NEF and AMC-CRV-FRs	We proposed in White River Junction that a subgroup of these stakeholders look into the positive benefits such as removal, modification, future uses, and so forth [of the barrier dam]. We recommend the creation of such a group, which can work cooperatively with TransCanada to better understand the issues and the option of removal.	As we stated during study plan meetings, removing the low-head dam in the bypassed reach is not planned during the ILP study phase. Consideration of the pros and cons of removing the dam, including methods of removal and permits required, may be more appropriate at a later time when the biological and recreational attributes of the bypassed reach under existing conditions have been defined.

Study 32 – Bellows Falls Aesthetic Flow Study

Commenter	Comment	Response
VANR	The licensee has incorporated many of the Agency's comments into the revised study plan, and it largely meets the Agency's requirements and we have no further comments. The licensee should incorporate the Agency's input as it refines and selects the observation point for the study.	We have revised the plan to clarify that we will consult with the working group to finalize the key observation points.

Study 33 – Cultural and Historic Resources Study

Commenter	Comment	Response
Narragansett Indian Tribal Historic Preservation Office	[Initial One Year Proposal includes statements associated with Tribal Concerns and a Specific Proposal to address them.] [Concerns noted in proposal]: How will these FERC re-licensing projects <u>foster and facilitate</u> meaningful Tribal Historic Preservation research and safeguards. No Tribe wishes to serve merely as historic preservation window dressing. Within the generally proposed area of potential effect of these re-licensing projects, impacts to sites of Tribal history and potential impacts to cultural resources loom as significant concerns. The broad brush strokes of research by non-Tribal researchers often generalize and blur the significance of Tribal historic and cultural sites as well as the locations and significance of surviving ancient native flora. From a Tribal Historic Preservation perspective, we wish to examine for ourselves the proposed APE and offer our own evidence based advisories. Normally, this is done in tandem with the standard survey process. From the Tribal cultural perspective, we seek to implement the identification efforts specified in the NHPA as *"background research, oral history interviews, sample field investigations and field survey."* [800.4 (b)(1)]	The study plan has been revised to include a Traditional Cultural Property Identification within the Wilder, Bellows Falls, and Vernon Projects based upon National Park Service Guidelines for Evaluating and Documenting Traditional Cultural Properties. TransCanada believes the specific methodology presented in the study request in large part mirrors the methodology outlined in detail within the revised study plan. Further elements outlined in the requested proposal are outside the parameters of what is required under Section 106 of the National Historic Preservation Act identification and evaluation phases and is not addressed in the study plan. Certain aspects of the proposal may be addressed during Section 106 consultation to resolve adverse Project effects, if any are identified.

Commenter	Comment	Response
Nolumbeka Project, Inc.	Study Request for Traditional Cultural Properties Study	The study plan has been revised to include a Traditional Cultural Property Identification within the Wilder, Bellows Falls, and Vernon Projects based upon National Park Service Guidelines for Evaluating and Documenting Traditional Cultural Properties. TransCanada believes the specific methodology presented in the study request in large part mirrors the methodology outlined in detail within the revised Study Plan.
Nolumbeka Project, Inc.	FirstLight and Trans Canada would like to eliminate steep slopes and or swamps or wetlands from study consideration. This request by the Licensee's is exactly why we recommended the need for more culturally sensitive and better-trained researchers. To address wetlands, Nolumbeka feels there needs to be an educational component that might help FirstLight, Trans Canada and FERC understand how important to Native cultural values wetlands have always been. Wetlands have been for thousands of years one of the most powerful gathering places for healing resources and ceremony, as well as foraging and are very often associated with ceremonial stone landscapes. To disregard the need to look more closely at wetlands is to marginalize a culture's ceremonial connection to the land, their history and values. Many important archaeological discoveries have been located in what were considered wetland areas. Nolumbeka would like to request that steep slopes and wetlands be included in the cultural studies, inventory and project boundaries discussions. If the Licensee's choose not to look at steep slopes and wetlands they will not have a complete inventory of the cultural resources in their project areas.	Steep slopes and wetlands within the Area of Potential Effect (APE) that are identified and evaluated as Traditional Cultural Properties (TCPs) through the TCP study will be treated as cultural resources.
Nolumbeka Project, Inc.	Nolumbeka also requests to be a part of the on the ground field studies and data analysis component of this project licensing process.	Tribal representatives will have the opportunity to conduct field investigations with the ethnographer conducting the TCP study.

Commenter	Comment	Response
Nolumbeka Project, Inc.	We are aware that a number of archaeological 1A studies have been done without tribal partnership. Trans Canada has requested the right to recycle an archaeological 1A study created five years ago under an old licensing issue without tribal participation or monitoring. We feel that is not the way to build trust with the tribes or the public and seem to not be congruent with the spirit of the 106 processes. Nolumbeka pointed out in our first letter to FERC that we felt it was important to bring on board professionals trained by the tribes to recognize the life ways and sacred practices and spaces of the indigenous peoples of this river valley culture. The Nolumbeka Project sees the recycling of Trans Canada's 5-year-old archaeological 1A study as a short cut that undermines the 106 processes.	The request refers to the Phase 1A survey conducted for the Vernon Project five years ago. The update and revision of that survey is a component of the study plan scheduled for the 2013 field season.
Nolumbeka Project, Inc.	In addition to the FERC, Massachusetts, Vermont and New Hampshire recommendation to do a Phase 1A Archaeological Survey and Historic Structure Survey, Nolumbeka requests that FERC consider requiring that survey to include Native American built stone structures, earthworks and ceremonial stone built landscapes in the APE as is the case in other states like Ohio, and if physically connected to go beyond the APE. Nolumbeka finds the APE maps we currently have to view, offer very little insight on what exactly is out there for cultural resources. Without the ability to review any studies that have been done, we find there is no way for us or the tribes to participate on the assessment of the applicability of the suggested APE Boundaries. Nolumbeka would like to review the research and compare it with what we know to exist in our archives before we would feel we have been allowed to be a contributor in this process.	Ceremonial structures within the Area of Potential Effect that are identified and evaluated as TCPs through the TCP study will be treated as cultural resources.
Nolumbeka Project, Inc.	As part of our study request 4, Nolumbeka and the Narragansett (THPO) asked for a study to create a centralized housing facility in the Gill Turners Falls area	The request is outside the parameters of what is required under Section 106 of the National Historic Preservation Act identification and evaluation phases

Commenter	Comment	Response
	for our archives and study programs, as well as a centralized housing facility to digitized and disseminate to appropriate tribes and researchers, the total of documents that have been amassed over the years on cultural studies done up and down the Connecticut River and in the surrounding area. The public perception at this time is that if just such a facility were in place now the current licensing process would be much streamlined as there would be no disconnect with what is out there and where it is and how it might impact any of the Licensee's projects on the river and beyond. There will be a need for just such a facility many times over the next 30 to 40 years of this license issue, and the Nolumbeka Project would be happy to team up with any of the tribes, the SHIPOs and the Licensees to create the protocols and institute such a program. Right now the cultural data that is out there is still in the early twentieth century mindset and access. This condition makes it difficult for a transparent exchange of data and research needed by the tribes and other interested parties to facilitate a balanced decision making process on the proposed Licenses for First Light and Trans Canada or any future projects that might need cultural impact consideration. The Nolumbeka Project feels our request could play an important part of creating a new attitude around Native American cultural preservation efforts here in the Connecticut River Valley and beyond and we strongly encourage FERC to support just such an endeavor.	and is not addressed in the study plan. Certain aspects of the proposal may be addressed during Section 106 consultation to resolve adverse Project effects, if any are identified.
VT SHPO	The Division is pleased to note that the July 8, 2103 version of the Study Plan 33, the Cultural and Historic Resources Study, contained the majority of the revisions discussed and suggested at the June 7, 2013 study plan meeting and during the July 2, 2013 phone conference call. Specifically, the addition of Phase IB	Study plan revisions reflect stakeholder consultation meetings and discussions held during the 3-month comment period.

Commenter	Comment	Response
	site identification and Phase II site evaluation components to the study plan clearly go a long way toward alleviating the gaps in the Section 106 site identification and evaluation process present in the Preliminary Application Documents (PADS) and original Study Plan 33.	
VT SHPO	[T]he Division believes that an APE determination to include 10 meters (33 feet) of land inland from the top of bank is the minimum acceptable APE limit. The Division accepts that the primary focus of any studies should be within areas of the APE that are actively eroding, but an APE limit of 10 meters around all Project margins for the purposes of historic property inventory and evaluation is appropriate. In fact, the recommended APEs in the updated study plan include this distance in association with actively eroding areas but some statements, such as the second paragraph on page 11 of the Study Plan, seem to imply that the APE definition to include the 10 meter extension is provisional on the results of hydraulic, operations, and erosion studies. As discussed at length in our March 1, 2013 comment letter on the PADS, and in the study plan meeting and conference call, the Division believes there is sufficient information at present to conclude that the Projects effects on bank destabilization, whether specifically determined to be direct or indirect, warrant Phase IB site identification and Phase II site evaluation studies on land adjacent to the impoundments and that such lands are contained within the APE.	The study plan has been revised to clarify that the recommended APEs for all three projects are defined as all land within the FERC project boundaries owned in fee simple by TransCanada and 10 meters (33 feet) of land inland from the top of bank in areas along the Connecticut River and project-affected portions of tributaries where TransCanada holds flowage rights. Phase 1B and Phase II Archaeological studies in the flowage rights areas will be conducted in those areas where active erosion was identified during the Phase 1A surveys for the Bellows Falls and Wilder Projects and the upcoming revised Phase 1A survey for the Vernon Project.
VT SHPO	Aside from clarification of the APE boundary, the Division generally supports the procedures and methodologies presented in the updated Study Plan for evaluating the Projects effect on both archaeological and structural historic properties. This includes the review of the draft Phase IA reports for the Wilder and Bellows Falls projects and the update to the Vernon	The study plan has been revised to define the APEs for the Wilder, Bellows Falls, and Vernon projects consistently as all land within the FERC project boundaries owned in fee simple by TransCanada and 10 meters (33 feet) of land inland from the top of bank in areas along the Connecticut River and project-affected portions of tributaries where TransCanada

<table>
<tr><th>Commenter</th><th>Comment</th><th>Response</th></tr>
<tr><td></td><td>Project Phase IA report following the completion of 2013 monitoring program. In the latter case, it does appear that any modification to the APE in Vernon based on identification of erosion or other threats to sensitive areas or sites as outlined on page 12 of the Study Plan conflicts with the statement on page 10 that the APE for the Vernon Phase IA adequately addresses project effects.</td><td>holds flowage rights.</td></tr>
<tr><td>VT SHPO</td><td>[T]he methodology and consultation procedures for the Phase IB site identification and Phase II site evaluations studies summarized in the Study Plan are adequate except that no provision is provided to address the potential presence of deeply buried cultural deposits. The final study plan should contain procedures to evaluate the potential for buried cultural deposits as well as proposed field techniques to address the need to sample at greater depths than can be generally attained by standard survey methods.</td><td>The study plan has been revised to include the methodology for identifying and investigating deeply buried cultural deposits.</td></tr>
<tr><td>VT SHPO</td><td>[T]he Division believes that the completion of the following Study Plan components is necessary to adequately address the Projects effects on cultural resources:

<u>Wilder, Bellows Falls and Vernon Projects</u>
Final determination of an APE that includes a minimum of 10 meters (33 feet) of land adjacent to the top of bank adjacent to the impoundments. Phase IB site identification studies will be focused on sections of the APE where active erosion or other project effect is occurring. Phase II site evaluation studies will also be focused on sites that are within actively eroding or otherwise effected sections of the APE but ultimately should include sites defined other portions of the APE to fully identify the number and location of the historic properties within the three project boundaries (see below project specific breakouts).</td><td>The study plan has been revised to include the APE as agreed upon in consultation with SHPOs and provides a schedule for completing the Phase IB and Phase II archaeological investigations, traditional cultural properties survey, and survey and evaluation of historic architectural resources as suggested in this comment.</td></tr>
</table>

Commenter	Comment	Response
	• Identification of Traditional Cultural Properties • Survey and Evaluation of Historic Architectural Resources	
VT SHPO	[T]he Division believes that the completion of the following Study Plan components is necessary to adequately address the Projects effects on cultural resources: <u>Wilder and Bellows Falls Projects</u> • Phase IB site identification within all archeologically sensitive areas and potential site locations within the APE that are actively eroding. • Phase II site evaluation of any archeological site identified in the Project APE as a result of the Phase IB survey or any known site that is located within a portion of the APE that is actively eroding to determine their boundaries and eligibility for inclusion on the National Register of Historic Places. • A phased plan to complete Phase II site evaluation of all remaining currently recorded archeological sites in the Project APE to determine their boundaries and eligibility for inclusion the National Register of Historic Places. • Both Phase IB site identification and Phase II site evaluation studies must include strategies to address deeply buried cultural deposits. • Development of a Historic Prope1ties Management Plan for each project.	The study plan has been revised to include the APE as agreed upon in consultation with SHPOs (described above) and provides a schedule for completing the Phase IB and Phase II archaeological investigations, methodology to address deeply buried cultural deposits, and development of historic property management plan for each project.
VT SHPO	[T]he Division believes that the completion of the following Study Plan components is necessary to adequately address the Projects effects on cultural resources: <u>Vernon Project</u>	The study plan has been revised to include the APE as agreed upon in consultation with SHPOs and provides a schedule for completing the Phase IB and Phase II archaeological investigations, methodology to address deeply buried cultural deposits, and revised historic property management plan for the project.

Commenter	Comment	Response
	• Phase IB site identification within the Project APE of all archeological sensitive areas and potential site locations that are actively eroding based on the 2013 Monitoring Report • Phase II site evaluation of any archeological site identified in the Project APE as a result of the Phase IB survey or any known site that is located within a p01tion of the APE that is actively eroding to determine their boundaries and eligibility for inclusion on the National Register of Historic Places. • A phased plan to complete Phase II site evaluations of all other known archeological sites in the Project APE to determine their boundaries and eligibility for inclusion in the National Register of Historic Places. • Both Phase IB site identification and Phase II site evaluation studies must include strategies to address deeply buried cultural deposits. • Development of a revised Historic Properties Management Plan.	

Comments on Excluded Studies

Excluded Study	Commenter	Comment	Response
Climate Change Model	CRJC	The role of climate change in influencing the impact of project operations on the ecology of the Connecticut River system should be addressed. While Tropical Storm Irene in 2012 appears to have resulted in one of the worst flooding situations in many years, it may not be the most extreme event that will occur in the future. Due to concerns about climate change, model runs should incorporate scenarios of more frequent and	TransCanada respectfully reiterates its position that there is no model that can accurately predict or describe future environmental climate related conditions. The selected hydrologic water years in Study 5 – Operations Modeling have significant variability that the capacity for the projects to handle or be affected by such variability will be tested and shown. Likewise the

Excluded Study	Commenter	Comment	Response
		intense storm events as well as future prolonged periods of drought to examine worse case conditions.	ability for the projects to adapt to such variability will also be evaluated. The results of which should enable a reasonable determination of what the projects can and cannot do in relation to environmental inputs. Developing local climate change predictions from current regional models and incorporating them into the operations model would be cost prohibitive (ILP Study Criterion 7). The additional information would not necessarily inform potential mitigation measures beyond the models TransCanada proposes to develop and utilize (ILP Study Criterion 4). Lastly, unforeseen climate change or any other environmental inputs can be addressed though existing FERC regulation and processes.
	CRWC	TC should be required to conduct a study based on CRWC Study Request 4 [climate change model]. In particular the study should rely on 30-50 year temperature increase models that incorporates thermal loading from the reservoirs. The other key element would be to anticipate how climate change predictions would affect management of high flow events at the three projects and evaluate if changes to the dam structures would mitigate adverse impacts on the facilities themselves.	
	NHDES	NHDES Study Request # 27: Climate Change and Continued Project Operations. NHDES Comments: Please see comments for Study # 5. [That comment was addressed in the response to study plan 5, but the comment is reproduced here] The study request submitted by NHDES requested that modeling be conducted to evaluate the potential effects of climate-altered flows on project operations over the course of the license. TransCanada's proposal does not address this objective, but should. Given studies such as those by researchers at the University of New Hampshire that show that flood and drought frequency in New Hampshire has changed over the past 40 years, and is very likely to continue to change, climate change scenarios are necessary. Much of this type of modeling is already underway around the state, though	

Excluded Study	Commenter	Comment	Response
		not in the Connecticut River. NHDES requests that TransCanada address how they will evaluate the potential effects of climate-altered flows on project operations over the course of the license in their study plan.	
	VANR	The Agency requested a study on climate change. TransCanada did not develop a study plan for this request… Since the Vernon, Bellows Falls and Wilder hydropower projects regulate the flow of the Connecticut River, their future operation will not be the same as it has been in the past… Operational modeling (Study 5) will be used to assess operating alternatives. However, this modeling is built on historic river gage records and historic operation of the projects, neither of which reflects future conditions. Modeling should include scenarios that are likely to be experienced during the upcoming license period. A climate change prediction model should be used in conjunction with other information about Connecticut River hydrology to predict the future river flow regime. This regime can then be used in conjunction with the operations model to assess new operating regimes that include environmental measures.	
Contingent Valuation Study	CRWC	AMC, NE Flow and American Whitewater called for a contingent valuation study. FERC should require TC to conduct an economic impact study on the value of a wide gamut of outdoor recreation activities including the value of whitewater opportunities.	TransCanada respectfully continues to consider it unnecessary to conduct a contingent valuation study pertaining to whitewater boating opportunities at Sumner Falls and the Bellows Falls bypassed reach. The potential whitewater boating opportunities must be defined and TransCanada plans to do this by
	NEF and AMC-CRV-FRs	TransCanada has declined requests to do a contingent valuation study of whitewater in	

Excluded Study	Commenter	Comment	Response
		the Bellows Falls bypass reach…	implementing Study Plan 31 – Whitewater Boating Flow Assessment. Similarly, it is unnecessary to conduct an economic valuation study of broader recreation activities. Existing and potential recreation opportunities must be defined and we plan to do this by implementing Study 30 – Recreation Facility Inventory and Use & Needs. As was the case in the initial request filed on March 1, 2013 by NEF, AW and AMC, the request lacks study methodology (ILP Study Criterion 6), level of effort and cost (ILP Study Criterion 7), and the nexus appears to be based on pre-project conditions rather than existing project operations (ILP Study Criterion 5).
Shad Population Model	NHDES	NHDES Study Request #6, Shad Population Model for the Connecticut River. NHDES Comments: Please see comments submitted by the New Hampshire Fish and Game Department.	TransCanada notes that NHFG did not submit additional written comments beyond those initially filed on the proposed study plan for a shad population model. As our Study Request Responsiveness Summary filed on April 16, 2013 and discussed in the study plan meetings states, for a number of reasons, TransCanada does not believe this is a reasonable request. The numerous American shad studies TransCanada proposes will identify project-specific effects on American shad. The cost to create a shad population model for the Connecticut River compared to the effects of the projects on the resource is excessive and hence does not meet ILP Study Criterion 7.

Excluded Study	Commenter	Comment	Response
Whitewater Park Feasibility Study	American Whitewater	In order to enhance the whitewater boating opportunity at Bellows Falls, American Whitewater requested that the licensee study the feasibility of developing a whitewater park in the natural bypassed reach at Bellows Falls. The licensee has declined to study this possibility, claiming that this is a mitigation request. While modifications and enhancements to the natural bypassed reach are a form of mitigation, a study of the feasibility of a whitewater park should be included in the flow study because it bears on the recreational opportunities in the natural bypass reach as well as the compatibility of whitewater flows with other interests that may be seeking restoration of flows to the natural bypassed reach. As such, we renew our request that FERC direct the licensee to include a whitewater park feasibility study as an element of the controlled whitewater flow study.	TransCanada respectfully disagrees and believes our study plan has been responsive to accessing white water boating suitability in the bypass reach. The concept of a whitewater park in itself is a form of enhancement which similar to all other forms of enhancements and mitigation; at this time we are not proposing to evaluate a specific form of recreation facility development. As a study to examine a mitigation option or proposal, it lacks a reasonable study nexus between the project operations and effects and the results would not inform the development of license requirements as required by ILP Study Criterion 5.

General Comments

General Topic	Commenter	Comment	Response
FirstLight / TransCanada Projects and Study Boundaries	CRWC	In numerous studies, the definition of the point where the TC study responsibility ends and the FirstLight responsibility begins has not been resolved to the satisfaction of CRWC. All study plans should clearly identify an agreed upon location where one applicant's responsibility ends and the other's starts so there will be no reach of the river that is not covered by these studies.	We respectfully disagree with the comment based upon study plan consultation meetings and discussions held by both TransCanada and First Light. The area of concern will be investigated by both parties in an attempt to examine respective operational influences and project effects on resources and habitat in this area. Study plans have been revised by identifying what TransCanada believes is a reasonable extent of project affected areas below which downstream projects play a significantly larger influencing contribution. In general, the extent of study areas is proposed as extending to "approximately 1.5 miles downstream of the dam, to the downstream extent of Stebbins Island". In order to provide evidence of FL or TC project effects, water level loggers will be installed in this area as well as points below, and this information will be associated with project operations before a final determination is made in consultation with FERC and stakeholders. We believe at this time that the area is adequately defined.
	NHDES	The extent of TransCanada's and FirstLight's study responsibilities downstream of the Vernon dam should be clarified so that study plan responsibilities can be assigned appropriately. It is our understanding at this time that TransCanada's studies will extend to the NH/MA border. It is stated [in the Updated PSP introduction - Relationship between TC and FL] that "... evaluation of Vernon Project impacts to the section below Vernon dam has been included in the updated study plans." The distance downstream of the dam should be stated.	
	VANR	FERC's Scoping Document 2 states that the Turners Falls impoundment extends to the base of the Vernon dam. During the study plan meetings held in May and June,	TransCanada strongly supports this position and request. TransCanada will require operational records and data from FirstLight in order to correlate it with water level

General Topic	Commenter	Comment	Response
		FirstLight stated that its hydraulic model indicates that the impoundment does not extend to the base of Vernon dam, but ends at a point downstream. TransCanada has subsequently included the reach downstream of the Vernon dam in the study area in all relevant study plans. The Agency requests that FirstLight provide information on the operation of its projects so that the frequency, duration, and periodicity of conditions when the Vernon discharge has a significant influence on this reach of river can be fully understood. This information is necessary for the Agency to evaluate seasonal flow requirements to protect aquatic biota and habitat downstream of Vernon dam.	monitoring data and Vernon operations in order to fully understand and evaluate the operations of the First Light Turners Falls and Northfield Mountain project on the study reach in common below Vernon Dam.
Floodplains	CRJC	Study results should be compiled as a comprehensive electronic topographic base map that extends laterally to at least the extent of the 500-year flood and include bathymetric mapping of instream features. It should show the locations of inventoried species as well as critical habitats. This base map should (1) show 1-foot contours and the extent of flooding during yearly, 100-year and 500-year storm events, (2) be scalable and (3) be available in the public domain.	Results of various studies will be mapped and resources affected by project operations will be identified. The informational needs of each study will determine the extent and level of detail included. We respectfully disagree that mapping for any study should extend to the 500-year flood plain, extents of various flooding events or be required to show 1-foot contours; none of which is associated with or necessary for evaluation of project operations. There is no nexus between this study and exercise and project operations and effects and therefore this study request does not meet ILP Study Criterion 5. TransCanada develops, updates and distributes dam breach inundation maps

General Topic	Commenter	Comment	Response
			under its FERC required Emergency Action Plans, outside of this ILP relicensing process for response agency evacuation planning purposes
Economic Impact Study Request	CRJC	<u>Request for an Economic Impact Study Plan</u> The economic impact of project operations has not been addressed in any of the study plans currently proposed. The economic impact of the projects operations, both positive and negative, affects many interests and relates to many resources. In order to assess the cost- benefit of various operational models, a comprehensive and objective assessment of these impacts, including on the local communities, must be made.	The baseline for ILP studies is current project operations and the existing resource effects (socioeconomics are described in section 3.13 of each project's PAD). We are not proposing to change project operations so there is no relative cost/benefit to be studied within this ILP study phase. If we propose project changes, economic impacts of those changes would be evaluated similarly to the effects on other environmental and public resources including renewable energy within the license application.
Recreation	American Whitewater	The licensee's proposed study plans will not adequately assess the demand for non-motorized boating in the project area. The licensee's proposed study plans will not assess the extent to which the inadequacy of its recreational facilities diminishes the recreational opportunities in the project area. The licensee has not sufficiently involved the boating community in the design and implementation of proposed recreation studies.	TransCanada respectfully disagrees and believes our study plan (Study 30 - Recreation Facility Inventory and Use & Needs) will adequately assess demand for all potential uses within the context of what the projects can reasonably provide and within the context of other regional opportunities; and that the plan will adequately assess the adequacy of its recreational facilities to meet current and future demand. The methodology applied in this study is technically sound and is consistent with generally accepted practice in the scientific community and broadening the scope of the study will not significantly add sufficient information for the level of additional effort and therefore this request does not adequately meet ILP Study Criterion 7.

General Topic	Commenter	Comment	Response
			We also believe that our study plan (Study 31 – Whitewater Boating Flow Assessment) is responsive to boating and recreation user group requests, subsequent discussions and comments received to date. Our proposals also include provisions for user groups' active participation in the study implementation phase.
Stakeholder Participation	CRWC	Throughout the studies, each of the Deliverables sections say: "Results and conclusions will be reported in either the PLP or the draft license applications for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application." The stakeholders in this process should have more time to review the final study conclusions prior to them being included in either the PLP or the draft final application, especially the NGOs without consultant assistance.	TransCanada has included provisions in the revised study plan for consultation with resource working groups and we expect that this process will provide ample opportunities for stakeholders to provide input into the studies as they are implemented. However, FERC sets the schedule for conducting ILP studies, filing study reports and stakeholder review and comment in accordance with the ILP requirements and timelines, as follows: Study progress reports will be filed during the spring/summer of 2014. Initial study reports will be filed and shared within one year of FERC's study plan approval and final study reports will be filed within two years of FERC's study plan approval. All reports will be made available to stakeholders for comment and discussion prior to the development and filing of draft license applications or Preliminary License Proposals by December 2015 (based on the current ILP schedule). The ILP process includes a process and

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			schedule for stakeholder meetings that will be held within 15 days of TransCanada's initial and file study report filings, and meeting summaries will be filed within 30 days of each meeting. In each case, stakeholders can file disagreements, proposed modifications and/or new study proposals within 30 days of filing of the meeting summaries. TransCanada will then respond in writing 30 days writing to disputes if necessary and FERC will issue a resolution of those disputes within 30 days if necessary.
Stakeholder Participation	NHDES	Many studies mention stakeholder workgroups (such as the erosion working group for Study #2) that will be consulted prior to and during various stages of the studies. NHDES requests to be on these working groups.	TC will add NHDES representatives, if not already identified, to all the working groups. Alternatively, NHDES can specify representatives to specific working groups on the website at any time at www.transcanada-relicensing.com
Operational Baseline	CRWC	Throughout the studies and in the conversations at the working group meetings TC referred to the study work as being "baseline" studies. Their assumption seemed to be that the way the river is now and the dams operate now would be how the river will be in the future with operations as they are right now. CRWC disputes that assumption.	These studies are designed to provide information about the effects of current project operations on the various natural resources, in that way they can be considered "baseline" studies. Studies 4 and 5 (Hydraulic Modeling and Operations modeling) will also look at a range of project operational alternatives and those potential effects on resources.
Project Lands	NPS	A comprehensive identification of licensee owned lands adjacent to the project boundary should be included in the application. GIS data can be overlain to show the project boundary, lands adjacent to it and areas which if developed could adversely impact river resources, from development and impact on aesthetic values to upland	As noted by the commenter, information on project lands will be included in the license application to be filed with FERC as a draft by December 2015 and as the final application by April 30, 2016. Future uses, and/or protection of existing project lands would be considered mitigation

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		land use practices that may adversely impact water quality and sedimentation. In some cases, these adjacent lands could be appropriate for providing additional recreational access to the river, new trails or connections to existing trails. Permanent protection of these lands would also confer aesthetic benefits to those using the river by providing views from the river of undeveloped lands. Regarding lands within the project boundary, those not integral to project operations should be permanently preserved and in many cases consist of prime agricultural lands. Even those lands currently under Agricultural Preservation Restrictions are only temporarily protected...	or enhancement measures to be addressed in a new license, not at this ILP study phase of relicensing.

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