TRANSCANADA HYDRO NORTHEAST INC.

BELLOWS FALLS HYDROELECTRIC PROJECT

FERC PROJECT NO. 1855

PRE-APPLICATION DOCUMENT

Project Location, Facilities, and Operation
18 C.F.R. § 5.6(d)(2)

Description of Existing Environment and Resources Impacts
18 C.F.R. § 5.6(d)(3)

Preliminary Issues and Studies List
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October 30, 2012

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TERMS, ACRONYMS, AND ABBREVIATIONS

APE	area of potential effects (as pertains to section 106 of the National Historic Preservation Act)
ASMFC	Atlantic States Marine Fisheries Commission
BCC	Birds of Conservation Concern
CEII	Critical Energy Infrastructure Information
cfs	cubic feet per second
CRASC	Connecticut River Atlantic Salmon Commission
CRJC	Connecticut River Joint Commissions
CSO	combined sewer overflow
DO	dissolved oxygen
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission ('the Commission")
FPA	Federal Power Act
FWS	U.S. Fish and Wildlife Service
HPMP	Historic Properties Management Plan
IBI	Index of Biotic Integrity
ILP	Integrated Licensing Process
IPANE	Invasive Plant Atlas of New England
ISO-NE	New England Independent System Operator
ITA	Indian Trust Assets
LBG	The Louis Berger Group, Inc.
mg/L	milligrams per liter
MIwb	Modified Index of Well-Being
msl	mean sea level
MW	megawatt
MWh	megawatt-hours
NAC	Northeast Aquatic Connectivity
National Register	National Register of Historic Places
NEP	New England Power Company
New Hampshire DES	New Hampshire Department of Environmental Services
New Hampshire DHR	New Hampshire Department of Historic Resources
New Hampshire Fish & Game	New Hampshire Fish and Game Department
New Hampshire NHB	New Hampshire Natural Heritage Bureau
NGO	non-governmental organization
NHPA	National Historic Preservation Act
NOI	Notice of Intent

Normandeau	Normandeau Associates, Inc.
NPDES	National Pollutant Discharge Elimination System
NWI	National Wetlands Inventory
PAD	Pre-Application Document
PM&E measures	Protection, mitigation, and enhancement measures
Project	Bellows Falls Project (FERC No. 1855)
Project area	The area within the FERC project boundary
Project boundary	The boundary line defined in the Project license issued by FERC that surrounds those areas necessary for safe and efficient operation and maintenance of the Project or for other specified Project purposes
Project vicinity	The general geographic area in which the Project is located
QHEI	Qualitative Habitat Evaluation Index
RM	river mile
RTE	Rare, threatened, and endangered
SCORP	Statewide Comprehensive Outdoor Recreation Plan
SHPO	State Historic Preservation Office
SWRPC	Southwest Regional Planning Commission
TCP	Traditional Cultural Property
TMDL	Total Maximum Daily Load
TransCanada	TransCanada Hydro Northeast Inc.
Tribes	Native American tribes
TWI	Targeted Watershed Initiative
USACE	U.S. Army Corps of Engineers
USASAC	U.S. Atlantic Salmon Assessment Committee
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
UVLSRPC	Upper Valley Lake Sunapee Regional Planning Commission
Vermont DEC	Vermont Department of Environmental Conservation
Vermont DHP	Vermont Division for Historic Preservation
Vermont Fish & Wildlife	Vermont Fish and Wildlife Department
Vermont NHIP	Vermont Natural Heritage Information Project
WAP	Wildlife Action Plan

INTRODUCTION

The Licensee, TransCanada Hydro Northeast Inc. (TransCanada), hereby files with the Federal Energy Regulatory Commission the required Pre-Application Document (PAD) for the relicensing of the existing Bellows Falls Hydroelectric Project (Project), FERC No. 1855. Power generated by the Project is sold through bilateral contracts or into the wholesale market administered by ISO New England and delivered to the grid via an interconnection to the regional transmission system.

The Project is located on the Connecticut River at river mile (RM) 173.7, about 1 mile upstream of Saxtons River and 3 miles downstream of the Williams River at the upper end of a sharp bend of the Connecticut River at Bellows Falls, Vermont, in the town of Rockingham, Vermont, and in the town of Walpole, New Hampshire. The Project extends upstream about 26 miles to Chase Island at Windsor Vermont, about 1 mile below the Windsor Bridge.

The Project consist of (1) a concrete gravity dam 643 feet long and 30 feet high, having a gated spillway with two roller gates and three stanchion flashboard bays; (2) the Bellows Falls reservoir, extending 26 miles upstream, having a surface area of 2,804 acres at normal full pond elevation of 291.63 feet msl; (3) a power canal 1,700 feet long with a forebay intake area and sluice gate; (4) a tailrace approximately 900 feet long; (5) a powerhouse containing three generating units, each rated at 13,600 kW; (6) transmission interconnection facilities; (7) fish passage facilities; and (8) appurtenant facilities.

The current license for the Project was issued by FERC in 1979 for a term of 40 years. On February 27, 1998, FERC approved the transfer of the license from New England Power Company to USGen New England, Inc. On January 24, 2005, FERC approved the transfer of the license to TransCanada Hydro Northeast Inc., the current Licensee. The current license expires on April 30, 2018.

The Licensee 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. This PAD accompanies the Licensee's Notice of Intent to File a License Application (NOI) to seek a new license for the Project. The Licensee is distributing the PAD and NOI simultaneously to federal and state resource agencies, local governments, Native American (FERC term is Indian) tribes (tribes), non-governmental organizations (NGOs), members of the public, and other parties potentially interested in the relicensing proceeding. The PAD provides FERC and the entities listed above with summaries of existing, relevant, and reasonably available information related to the Project that was in the Licensee's possession as supplemented by a due diligence search. The information required in the PAD is specified in 18 C.F.R. § 5.6 (c) and (d).

The Licensee exercised due diligence in preparation of this PAD by contacting appropriate governmental agencies, tribes and others potentially having relevant information and by conducting extensive searches of publically available databases and its own records. In addition, the Licensee performed studies as described in section 3 of this PAD to augment readily available information on issues of concern to our stakeholders.

The existing, relevant, and reasonably available information presented in this PAD provides Interested Parties in this relicensing proceeding the information necessary to identify issues and related information needs and develop study requests preceding the Licensee's Application for a New License (License Application), which must be filed with the FERC on or before April 30, 2016.

The PAD is also a precursor to the environmental analysis section of the License Application and to the FERC's Scoping Documents and Environmental Impact Statement, or Environmental Assessment, under the National Environmental Policy Act. Filing the PAD concurrently with the NOI enables those who plan to participate in the relicensing to familiarize themselves with the Project at the start of the proceeding. This familiarity is intended to enhance the FERC scoping process that follows issuance of the PAD.

1.0 PROCESS PLAN, SCHEDULE, AND PROTOCOLS

1.1 OVERALL PROCESS PLAN AND SCHEDULE

TransCanada developed this process plan and schedule in accordance with the timeframes established in 18 C.F.R. Part 5 based on a NOI filing date of October 30, 2012. The process plan and schedule in table 1.1-1 outline the specific timeframes, deadlines, and responsibilities of FERC, TransCanada, and other stakeholders in the ILP from the filing of the NOI and PAD through filing of the License Application. By regulation, TransCanada, resource agencies, tribes, and FERC must adhere to this regulatory schedule. TransCanada is committed to working with all stakeholders to ensure the expeditious resolution of any issues.

1.2 SCOPING MEETINGS AND SITE VISIT

Pursuant to 18 C.F.R. § 5.8 (b), FERC is required to hold a site visit and scoping meetings. Although FERC typically conducts an environmental site review at approximately the same time as the scoping meetings, in this instance FERC conducted a publicly noticed environmental site review at the Project on October 2, 2012, due to the potential for inclement weather and winter conditions restricting viewing opportunities of the reservoir at the time of the scheduled scoping meetings. Typically, FERC conducts two scoping meetings with one meeting held during the day to focus on the solicitation of comments and information from resource agencies and tribes and the second meeting held in the evening to facilitate participation from the public and NGOs. FERC will provide public notice of the scoping meetings. All interested parties are invited to participate in the meetings. Additional information regarding the scoping meetings may also be obtained by contacting:

Mr. Kenneth Hogan
Federal Energy Regulatory Commission
(202) 502-8434
Kenneth.Hogan@ferc.gov

1.3 PROCESS PLAN AND SCHEDULE

TransCanada intends to follow the process plan and schedule provided in table 1.1-1, consistent with the ILP process (18 C.F.R. § 5).

Table 1.1-1. Bellows Falls proposed process plan and schedule

18 C.F.R.	Lead	Activity	Timeframe	Deadline[a]
§ 5.5 (a)	TransCanada	Deadline to File NOI		10/30/2012[b]
§ 5.6 (a)	TransCanada	Deadline to File PAD		10/30/2012
§ 5.7	FERC	Initial Tribal Consultation Meeting	Within 30 Days of filing NOI and PAD	12/3/2012

18 C.F.R.	Lead	Activity	Timeframe	Deadline[a]
§ 5.8(a) b(2)	FERC	FERC Issues Notice of Commencement of Proceeding and Scoping Document (SD1) and requests to initiate informal consultation under Section 7 of the Endangered Species Act and section 106 of the NHPA	Within 60 days of filing NOI and PAD	12/29/2012
§ 5.8 (b)(3) (viii)	FERC / Stakeholders	Public Scoping Meeting	Within 30 days of NOI and PAD notice and issuance of SD1	1/30/2013
§ 5.9	Stakeholders	File Comments on PAD, SD1, and Study Requests	Within 60 days of NOI and PAD notice and issuance of SD1	2/27/2013
§ 5.10	FERC	FERC Issues Scoping Document 2 (SD2) (if necessary)	Within 45 days of deadline for filing comments on SD1	4/13/2013
§ 5.11(a)	TransCanada	File Proposed Study Plans	Within 45 days of deadline for filing comments on SD1	4/13/2013
§ 5.11 (e)	TransCanada / Stakeholders	Study Plan Meetings	Within 30 days of deadline for filing proposed Study Plans	5/13/2013
§ 5.12	Stakeholders	File Comments on Proposed Study Plan	Within 90 days after proposed study plan is filed	7/12/2013
§ 5.13 (a)	TransCanada	File Revised Study Plan (if necessary)	Within 30 days following the deadline for filing comments on proposed Study Plan	8/11/2013
§ 5.13 (b)	Stakeholders	File Comments on Revised Study Plan (if necessary)	Within 15 days following Revised Study Plan	8/26/2013
§ 5.13 (c)	FERC	FERC Issues Study Plan Determination	Within 30 days following Revised Study Plan	9/10/2013
§ 5.14 (a)	Stakeholders/ FERC	Formal Study Dispute Resolution Process (if necessary)	Within 20 days of Study Plan determination	9/30/2013
§ 5.14(l)	FERC	Study Dispute Determination	Within 70 days from notice of study dispute	12/9/2013

18 C.F.R.	Lead	Activity	Timeframe	Deadline[a]
§ 5.15 (a)	TransCanada	Conduct First Season Field Studies	Spring/summer 2014	
§ 5.15 (b)	TransCanada	File Study Progress Reports	Spring/summer 2014	
§ 5.15 (c)(1)	TransCanada	File Initial Study Reports	No later than one year from Study Plan approval	9/10/2014
§ 5.15 c)(2)	TransCanada	Initial Study Results Meeting	Within 15 days of Initial Study Report	9/25/2014
§ 5.15 (c)(3)	TransCanada	File Study Results Meeting Summary	Within 15 days of Study Results Meeting	10/10/2014
§ 5.15 (c)(4)	Stakeholders/ FERC	File Meeting Summary –Dispute/Modifications to Study/Propose New Studies (if necessary)	Within 30 days of filing Meeting Summary	11/9/2014
§ 5.15 (c)(5)	TransCanada	File Responses to Disputes (if necessary)	Within 30 days of disputes	12/9/2014
§ 5.15	FERC	Dispute Resolution (if necessary)	Within 30 days of filing responses to disputes	1/8/2015
§ 5.15	TransCanada	Conduct Second Season Field Studies	Spring/summer 2015	
§ 5.15 (f)	TransCanada	File Updated Study Reports	No later than two years from Study Plan approval	9/10/2015
§ 5.15 (f)	TransCanada	Second Study Results Meeting	Within 15 days of Updated Study Report	9/25/2015
§ 5.15 (f)	TransCanada	File Study Results Meeting Summary	With 15 days of Study Results Meeting	10/10/2015
§ 5.15 (f)	Stakeholders / FERC	File Meeting Summary Disputes/ Modifications to Study/Propose New Studies (if necessary)	Within 30 days of filing Meeting Summary	11/9/2015
§ 5.15 (f)	TransCanada / Stakeholders	File Responses to Disputes (if necessary)	Within 30 days of disputes	12/9/2015
§ 5.16 (a)	TransCanada	File Preliminary Licensing Proposal (or Draft License Application) with the FERC and distribute to Stakeholders	Not later than 150 days before final application is filed	12/2/2015

18 C.F.R.	Lead	Activity	Timeframe	Deadline[a]
§ 5.16 (e)	FERC / Stakeholders	Comments on TransCanada Preliminary Licensing Proposal, Additional Information Request (if necessary)	Within 90 days of filing Preliminary Licensing Proposal (or Draft License Application)	3/1/2016
§ 5.17 (a)	TransCanada	License Application Filed		4/30/2016

[a] This schedule may adjust based upon filing dates of required documents. When a regulatory deadline falls on a weekend or federally recognized holiday, the actual due date will be by the close of the next business day.

[b] The earliest date that TransCanada can file the NOI/PAD.

1.4 PROPOSED COMMUNICATION PROTOCOL

TransCanada is proposing a Communication Protocol (Protocol) to provide guidelines for effective participation and communication in the Project relicensing process. The Protocol pertains to TransCanada, governmental agencies, NGOs, tribes, and unaffiliated members of the public who participate in the proceedings. The primary means of communication will be meetings, formal documents, email, and telephone. To establish the formal consultation record, all formal correspondence requires adequate documentation. This Protocol provides a flexible framework for dissemination of information and documenting consultation among all Project relicensing participants. This document may be revised from time to time, in consultation with participants, and will be posted to the relicensing website (www.transcanada-relicensing.com). The Protocol remains in effect until FERC issues a new license for the Project.

1.4.1 Participants

TransCanada Relicensing Team – The Relicensing Team will consist of staff and consultants of TransCanada who are responsible for the conduct of relicensing activities within the scope of their authority. TransCanada will assume the lead role in most matters for the purposes of contact, communication, and management of relicensing activities. Consultants cannot speak for or bind TransCanada in any matter. TransCanada's relicensing manager and primary contact for this Project is Mr. John Ragonese:

Mr. John Ragonese
Relicensing Project Manager
TransCanada Hydro Northeast Inc.
4 Park Street, Suite 402
Concord NH 03301
(603) 498-2851
john_ragonese@transcanada.com

FERC – Mr. Kenneth Hogan will serve as the team leader for the FERC team assigned to this initiative. Both FERC staff and contracted consultants for FERC will be referred to as FERC throughout the process. FERC team members will be identified on the TransCanada relicensing website (www.transcanada-relicensing.com). Mr. Hogan will participate in relicensing meetings and provide guidance during the process. FERC's role will be in accordance with the rules and regulations for the ILP (see the FERC website for details http://www.ferc.gov/industries/hydropower.asp). For any questions related to FERC communications, contact Mr. Hogan at kenneth.hogan@ferc.gov or at 202-502-8434.

Parties interested in the Bellows Falls Project relicensing have various options for identifying themselves and their interest based upon level of participation and formal status. Identification of these parties can be through lists maintained by either TransCanada or FERC. TransCanada will have an interested parties list and a relicensing participants list. The distinction between the two is as follows:

- ***Interested Parties*** is the broad group of individuals and entities that have identified themselves to TransCanada or FERC either prior to or following the issuance of the NOI as interested in the relicensing proceedings. They include tribes, state and federal agencies, local governments, NGOs, and private citizens. The initial list to whom the NOI was distributed pursuant to the FERC regulations in 18 C.F.R. § 5.5(c) was derived from a combination of the FERC mailing lists, the FERC service lists, parties identified through previous consultation or outreach, municipal officials, and abutters or parties with land within the Project boundary.

  Any party that desires to be added to or removed from the interested parties list should either return the prepaid postcard accompanying the NOI, indicating they wish to be removed, send an email to info@transcanada-relicensing.com or send a written request to Mr. John Ragonese at the address or email above. Parties requesting to be added to the interested parties list should provide the following contact information: name, e-mail, mailing address, phone, affiliation if appropriate, and resource area of interest. A current list of interested parties (excluding for privacy reasons, abutting landowners) will be maintained and updated on the TransCanada relicensing website (www.transcanada-relicensing.com).

- ***Relicensing Participants*** is a subset of interested parties and consists of individuals and entities who will actively participate in the relicensing proceeding, working meetings, consultation, collaboration and negotiations.

FERC maintains several lists that identify parties interested in relicensing of the Project. They include the formal service list, a subscription list, and a mailing list.

- ***Service List*** – The FERC establishes an official Service List specific to the Bellows Falls Project for parties who formally intervene (Intervener) in the proceeding. Additional information may be found on FERC's website at www.ferc.gov. Once FERC establishes a Service List, any written documents filed with FERC must also be sent to the Service List. A Certificate of Service must be included with the document filed with FERC. The official service list is available on FERC's website.

- ***Mailing List*** – A list of names and addresses of contacts on the Service List and contacts that are non-Interveners but who may have communicated with the FERC specific to the project or a docket associated with the project.
- ***eSubscription*** – This is an undisclosed list of parties that wish to be alerted to filings made to FERC specific to the project or a docket associated with the project. Parties on this list receive email notifications of filings posted to the eLibrary (the searchable electronic document database maintained by FERC) including a link to the subject document itself.

Any party requesting to be added to the service list should also register for eSubscription of filings associated with the Bellows Falls Project.

1.4.2 Relicensing Websites

TransCanada has established a publicly accessible internet website as a means of making relicensing information and resource information readily available to participants. It will serve as the Public Information or Document Room. It is available at www.transcanada-relicensing.com. A publicly accessible computer terminal for accessing the website will also be available during business hours at TransCanada's office located at 2 Killeen Street, North Walpole, New Hampshire. See section 1.4.5 below for more information on access to that facility. Pertinent information posted to the website will include the process plan and schedule and communication protocol, TransCanada and FERC contacts, calendar, meeting agendas and summaries, reports, and relicensing documents (e.g., PAD, NOI, study plans, preliminary licensing proposal or draft license application, and study reports). Additional information on the website will include operational and background information, the ILP relicensing timeline and how the process works, a list of interested parties who are involved, a project library, and a photo gallery. A library of pertinent historic studies will also be available on the website.

FERC's website is also a valuable resource for relicensing documents and is located at: www.ferc.gov. Documents related to the Project relicensing can be accessed by clicking on the eLibrary link and conducting a general search on the Project docket number (P-1855).

1.4.3 General Communications

TransCanada's goal is to keep the lines of communication open during the relicensing process and facilitate the flow of information between TransCanada, FERC and participants. All participants will informally communicate with each other; however, participants are encouraged to share relevant communications among all participants working on specific resource issues.

Verbal communications at meetings and e-mail will be the primary means of formal communication among participants. TransCanada anticipates that individual and conferencing telephone calls among participates will be treated informally, with no specific documentation unless specifically agreed upon in the discussion or as part of formal agency consultation proceedings.

1.4.3.1 FERC Communication

All written communications to FERC regarding project relicensing must reference the "Bellows Falls Hydroelectric Project FERC No. P-1855 - Application for New License." The sub-docket number assigned by FERC after TransCanada files the NOI should also be included. Comments filed with FERC prior to TransCanada's submission of a final license application for the Project should be copied to TransCanada and interested parties. After FERC issues a formal notice of acceptance of TransCanada's application, and notice that the application is ready for environmental analysis, intervenors submitting comments to FERC about Project relicensing are required to serve said comments to each person on the official service list as well as to TransCanada (18 C.F.R. § 385.2010 (a)). FERC will issue a notice when it is soliciting motions to intervene on a specific proceeding. The official service list is available on FERC's website (see section 1.4.1).

FERC strongly encourages paperless electronic filing of comments and interventions. To eFile comments and/or interventions, interested parties must have an eRegistration account. After preparing the comment or motion to intervene, go to www.ferc.gov, and select the eFiling link. Select the new user option, and follow the prompts. Users are required to validate their account by accessing the site through a hyperlink sent to the registered email account.

An additional method to eFile comments is through the "Quick Comment" system available via a hyperlink on the FERC homepage. "Quick Comments" do not require the users to be registered; the comments are limited to 6,000 characters; and all information must be public. Commenters are required to enter their names and email addresses. They will then receive an email with detailed instructions on how to submit "Quick Comments."

Stakeholders without internet access may request to be added to the mailing list and/or submit comments via hard copy. Send the request or comments to the address below. Official motions to intervene require sending the original and three copies to the address below.

Honorable Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, D.C. 20426

1.4.4 Meetings

Public participation in the ILP is encouraged. Meetings will generally fall into three categories: Public Information Meetings sponsored by TransCanada; FERC Public Meetings to meet its obligations under the National Environmental Policy Act; and Working Group meetings between TransCanada, FERC, and relicensing participants working on or discussing issues and studies specific to a particular resource, issue or interest.

Under the ILP, FERC will hold a public scoping meeting within 30 days of FERC issuing its Scoping Document 1 and notice of commencement of relicensing proceeding corresponding with its acceptance of the NOI and PAD. It is anticipated that any meeting required by FERC to meet its obligations under the National Environmental Policy Act or applicable regulation will be scheduled and noticed by FERC. In accordance with 18 C.F.R. § 5.8(e), the FERC scoping meetings will be publicly noticed by FERC in the *Federal Register* and in the daily or weekly local newspapers. TransCanada will include notice of these scoping meetings on the public relicensing website.

TransCanada may hold periodic Public Information Meetings thereafter to review and provide opportunities for consultation with members of the public on such matters as the proposed study plan, study review and reporting, the preliminary licensing proposal and the draft environmental analysis. TransCanada will incorporate these additional meetings and schedules into the ILP schedule in a manner that will work to avoid or minimize scheduling conflicts. To the extent possible, TransCanada will notify (by email or U.S. mail as available) interested parties at least 15 days prior to the meeting date for all meetings. TransCanada will also post the dates, times and locations for Public Information Meetings on the public relicensing website.

In addition, TransCanada may schedule periodic Working Group Meetings among entities and persons with interests in a specific resource area to address specific issues, develop study plans, or negotiate terms and conditions. Working Group Meetings will be scheduled with the members of these technical working groups, and posted to the public relicensing website.

TransCanada will distribute a full agenda at the meetings, and participants may suggest changes to the agenda at the meeting. TransCanada will post draft meeting summaries for the ILP study plan and study results meetings (18 C.F.R. § 5.11 (e) and § 5.15 (c)(2) respectively) and on the public relicensing website within two weeks following each meeting. Generally, the summaries will include the participant list, discussion points, decisions, action items, and location and date of the next meeting. Meeting participants are asked to provide redlined comments to the draft meeting summaries within two weeks of the posting of the draft meeting summary. TransCanada will incorporate the comments received and post a final meeting summary to the website. Any comments received along with the final version of the respective meeting summaries will be included in the consultation record submitted with the license application.

Discussion, as well as dissemination of agendas, meeting summaries and materials may be closed to the public when matters under review contain information, which if disclosed could endanger sensitive cultural resource sites, or species protected under the ESA.

Meetings will generally be held in locations accessible to all those attending. Meeting participants may at any time request short breaks for the purpose of a caucus. Relicensing participants are encouraged to caucus outside the regularly scheduled meetings. P- and cooperation

1.4.5 Public Reference File

Until FERC issues a new license for the Project, TransCanada will maintain a virtual Public Reference Room through the website www.transcanada-relicensing.com where copies of the NOI, PAD, PAD supporting materials, and unrestricted published studies will be kept. Access to these materials will be open except for sensitive information as described in section 1.4.5.1. There will be no charge for viewing the documents online. A computer terminal accessing the website and virtual Public Reference Room will be maintained at the TransCanada office at 2 Killeen Street, North Walpole, New Hampshire. Access to the facility is controlled and requires an escort and advance notice by contacting Mr. John Ragonese at the phone, email, or address provided in section 1.4.1.

All requests for public records should clearly indicate the document name, publication date (if known), and FERC Project No. 1855. A reproduction charge and postage costs may be assessed for hard copies requested by the public. Federal, state, and tribal entities will not be subject to document-processing or postage fees.

Public reference files will be filed with FERC and available on FERC's eLibrary by searching by the FERC project docket number (P-1855). In addition, all materials in the public reference files will be available for review and copying at the FERC offices in Washington, DC:

> Federal Energy Regulatory Commission
> Public Reference Room, Room 2-A
> Attn: Secretary
> 888 First Street, N.E.
> Washington, DC 20426

1.4.5.1 Sensitive Information

Certain Project related documents are restricted from public viewing in accordance with FERC regulations. Specifically, Critical Energy Infrastructure Information (CEII) (defined in 18 C.F.R. § 388.113) is information related to the design and safety of dams and appurtenant facilities, and is exempt from mandatory disclosure under the Freedom of Information Act because of national security and public safety. Access to CEII is restricted in accordance with federal regulations. Anyone seeking CEII from FERC must file a CEII request. FERC's website at www.ferc.gov/help/how-to/file-ceii.asp contains additional details related to CEII.

Information related to protecting sensitive archaeological or other culturally important information is also restricted under section 106 of the National Historic Preservation Act. Anyone seeking this information from FERC must file a Freedom of Information Act request. Instructions for Freedom of Information Act requests are available on FERC's website at www.ferc.gov/legal/ceii-foia/foia.asp.

In addition, information that may reveal the locations of rare, threatened, and endangered species is protected under section 7 of the Endangered Species Act (ESA) and/or state regulations. This includes all species (plant and animal) listed, proposed for listing, or candidates for listing under the federal and state endangered species acts.

Participants may also submit data requests for sensitive information to john_ragonese@transcanada.com. Requests for access to this information will be evaluated under TransCanada's policies, relevant FERC regulations, and applicable laws. Parties requesting sensitive information may be required to sign a non-disclosure agreement pertaining to the specific material requested.

1.4.6 Document Distribution

TransCanada will distribute, whenever possible, all documents electronically in standard Microsoft Office formats (.doc, .xls, .ppt) or portable document format (PDF), image (jpeg) or as GIS shapefiles (.shp) or published map files (.pmf) either via email or on CD, and will post all relevant relicensing documents on the TransCanada relicensing website. TransCanada may distribute hard copies of some documents for convenience or by request (copy fees may be requested). Unless otherwise specified, the following procedures will be used for document distribution:

Document	Distribution Path	Participant
Public meeting notices	By website, email, and/or newspaper	Interested parties, FERC service list
Meeting summaries	Website, email	Relicensing participants
Major documents[a]: FERC scoping documents, proposed study plans, study reports, draft license application, etc.	Website. FERC eLibrary, email and normal or express mail	Notice of availability by email to interested parties
Study plan comments / summary	Website	Notice of availability by email to interested parties
General correspondence	Email	Interested parties or as applicable
Progress/status report	Website	Notice of availability by email to interested parties

[a] TransCanada expects to distribute the final license application on CDs via U.S. mail or overnight mail.

TransCanada is also providing a paper copy of the NOI, PAD, proposed study plan, final study plan, preliminary license proposal or draft license application, and final license application to public libraries located near the Project. These libraries, their addresses, and their phone numbers are as follows:

Towns	Public Library
Walpole NH	Walpole Town Library 48 Main Street PO Box 487 Walpole, NH 03608-0487 (603-756-9806)
Charlestown NH	Silsby Free Public Library 226 Main Street PO Box 307 Charlestown, NH 03603-0307
Claremont NH	Fiske Free Library 108 Broad Street Claremont, NH 03743-2673 (603-542-7017)
Cornish NH	George H. Stowell Free Library School Street Cornish Flat, NH 03746-0360 (603-543-3444)
Rockingham VT	Rockingham Free Public Library 65 Westminster Street Bellows Falls, VT 05101 (802-463-4270)
Springfield VT	Springfield Town Library 43 Main Street Springfield, VT 05156-2997 (802-885-3108)
Weathersfield VT	Proctor Library 5181 Route 5 Ascutney, VT 05030-0519 (802-674-2863)
Windsor VT	Windsor Public Library 43 State Street Windsor, VT 05089-1213 (802-674-2556)

1.5 STUDY REQUESTS

As part of early consultation and collaboration efforts, TransCanada will work with interested parties and relicensing participants to identify areas where there is little or no information relevant to issues of potential concern for project effects to the human and natural environments. Study requests must meet the requirements of the FERC regulations.

As specified by 18 C.F.R. § 5.9(b) of FERC's ILP regulations, any study request must:

- Describe the goals and objectives of each study proposal and the information to be obtained;
- If applicable, explain the relevant resource management goals of the agencies or tribes with jurisdiction over the resource to be studied;

- If the requestor is not a resource agency, explain any relevant public interest considerations in regard to the proposed study;
- Describe existing information concerning the subject of the study proposal, and the need for additional information;
- 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;
- 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; and
- 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 requestor should also describe any available cost-share funds or in-kind services that the sponsor of the request may contribute towards the study effort. Email completed draft study requests in Microsoft Word or PDF format to John Ragonese at john_ragonese@transcanada.com.

2.0 PROJECT LOCATION, FACILITIES, AND OPERATIONS

2.1 PROJECT LOCATION

The Project's dam, canal and powerhouse are located on the Connecticut River at RM 173.7, about 1 mile upstream of Saxtons River and 3 miles downstream of the Williams River at the upper end of a sharp bend of the Connecticut River at Bellows Falls, Vermont, in the town of Rockingham, Vermont, and in the town of Walpole, New Hampshire. The Project impoundment extends upstream about 26 miles to Chase Island at Windsor Vermont, about 1 mile below the Windsor Bridge.

Interstate Route 91 and Route 5 run along the Vermont side of the valley, while N.H. Route 12 runs along the New Hampshire side. The tracks of the Boston and Maine Railroad run along the New Hampshire side, and the tracks of the Green Mountain Railroad Corporation run along the Vermont side before branching away from the river at the Williams River. The Project lies within 8 communities: Walpole, Charlestown, Claremont, and Cornish in New Hampshire (Cheshire and Sullivan counties); and Rockingham, Springfield, Weathersfield, and Windsor (Windham and Windsor counties) in Vermont. Figure 2.1-1 illustrates the primary Project facilities, figure 2.1-2 shows the Project constructed works layout, and table 2.1-1 summarizes Project information.

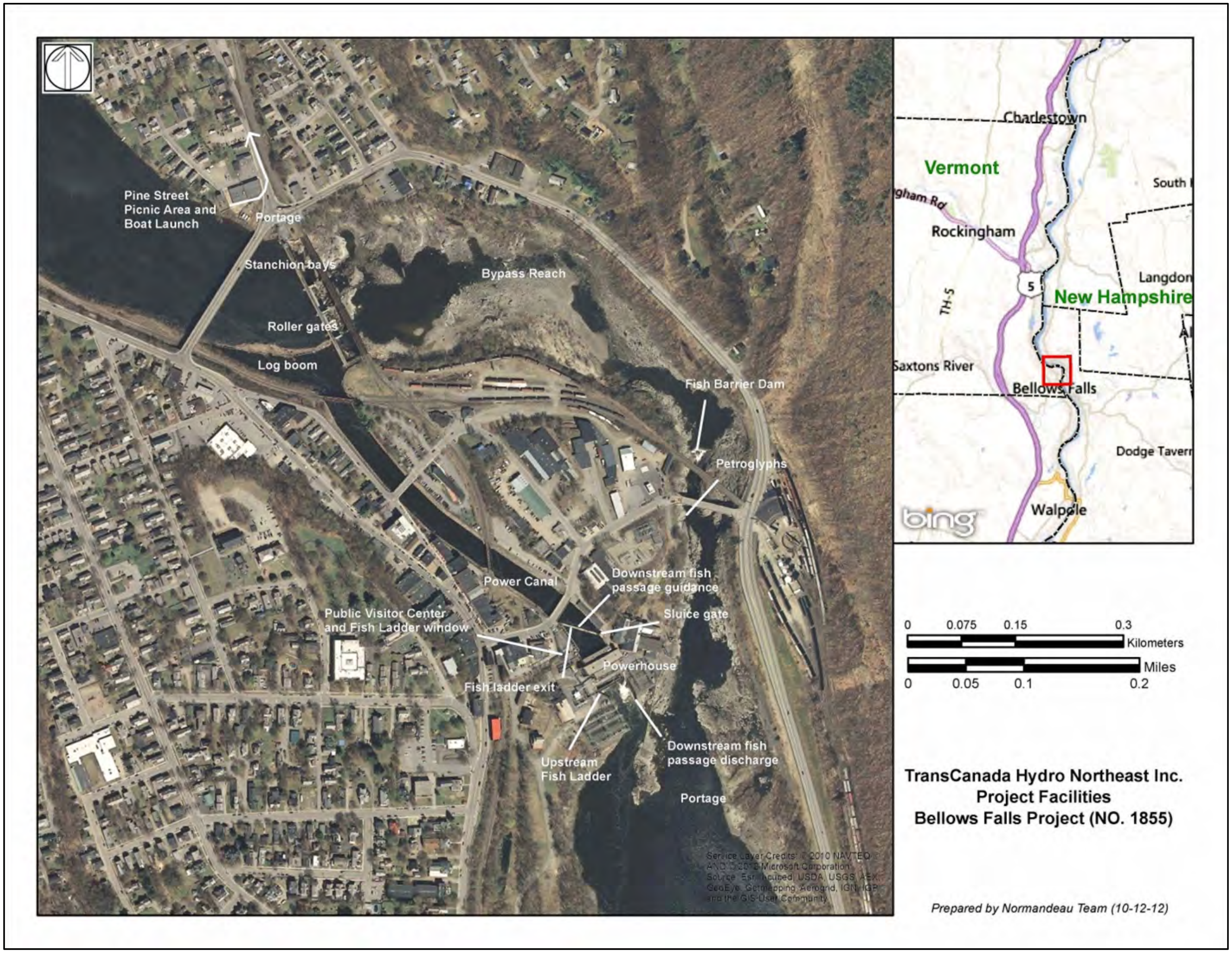

Figure 2.1-1. Primary Project facilities.

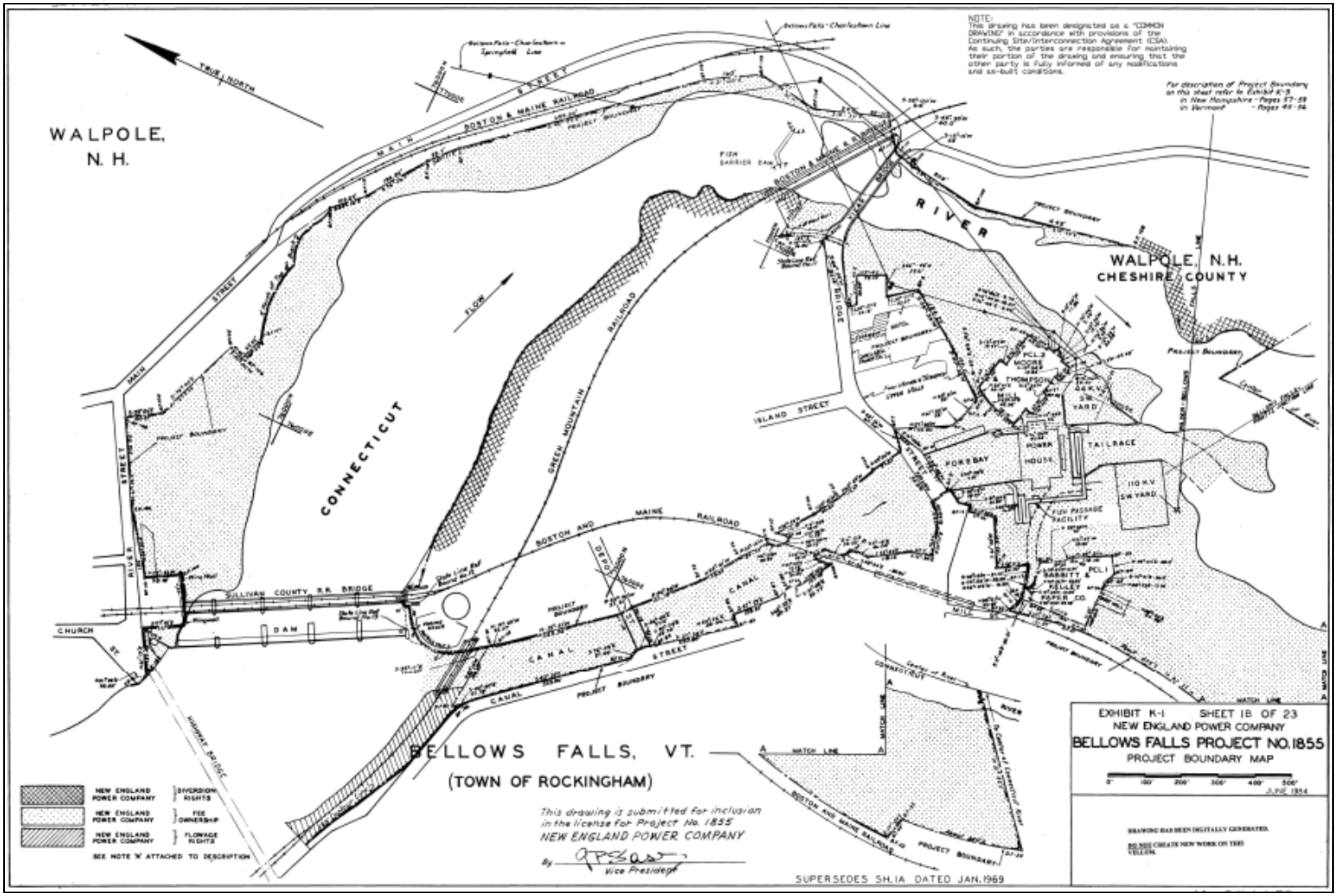

Figure 2.1-2. Project constructed works layout.

Table 2.1-1. Project summary.

General Information	
Owner	TransCanada Hydro Northeast Inc.
FERC Project Number	P-1855
Current License Term	August 3, 1979 – April 30, 2018
Authorized Generating Capacity	40.8 megawatts (MW)
Bellows Falls Project	
Location of Dam	Connecticut River at river mile 173.7
Nearest Towns / Counties	Rockingham, Windham County, Vermont Walpole, Cheshire County, New Hampshire
Drainage Area	5,414 square miles
Major Tributaries	NH – Mascoma and Sugar Rivers VT – White, Ottauquechee, Black and Williams Rivers
Operating Range Elevation	288.6 – 291.6
Normal Range Elevation[a]	289.6 – 291.4
Normal Tailwater Elevation	229.0
Impoundment Length	26 miles (Cornish, NH/Windsor, VT)
Gross Storage	26,900 acre-feet
Useable Storage	7,476 acre-feet (at 3-foot drawdown)
Surface Area at Normal Full Pond	2,804 acres
Average Annual Inflow at the Project	Approximately 10,500 cfs
Required Minimum Flow	1,083 cfs or inflow, whichever is less
Generated Minimum Flow[a]	1,300 cfs

Major Structures and Equipment	
Original Construction	1928
Dam	Concrete gravity type construction, 643 feet long, with maximum height of 30 feet and net head of 60.5 feet
Spillway Gates	2 steel roller gates, 3 stanchion bays, 1 forebay sluice gate
Bypass Reach	Natural river bed approximately 3,500 feet long, minimal flow from leakage
Powerhouse Intake Canal	Paving stones stabilized by a grid of concrete grade beams and walls with a concrete walled forebay; 100 feet wide at the top, approximately 36 feet wide at the bottom, 29 feet deep, and 1,700 feet long
Powerhouse	Steel frame and brick construction, 186 feet by 106 feet
Turbine/Generator Units	3
Turbine Manufacturer/Type	S. Morgan Smith / vertical Francis
Turbine Capacities	Each - 16 MW / 18,000 hp / 3,670 cfs @ 57 feet head
Generator Manufacturer	General Electric
Generator Capacities	Each – 17,000 KVA / 13,600 KW with 0.8 power factor
Total Discharge Capacity	119,785 cfs
Fish Ladder	Reinforced concrete; vertical slotted weir fish ladder with 67 pools (12 inch rise), collection facility, and viewing windows
Upgrades	Fish ladder installed in 1984, downstream fish diversion barrier completed in 1996, and the station automated with remote control capability in 1998

[a] Reflects typical non-spill, non-emergency operation.

2.1.1 Project Authorized Agents

The following persons are authorized to act as agent for the Licensee pursuant to 18 C.F.R. § 5.6(d)(2)(i):

Mr. John Ragonese
Relicensing Project Manager
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erin_odea@transcanada.com

2.2 PROJECT LICENSE HISTORY AND AMENDMENTS

The original license for the Project was issued jointly to New England Power Company, Bellows Falls Hydro-Electric Corporation, and the Connecticut River Power Company on October 13, 1943. New England Power Company subsequently purchased all of the physical properties and franchise of Bellows Falls Hydro-Electric Corporation and became the Licensee, as authorized by FERC under its Order dated July 9, 1948.

In 1962, land easements and deeds were granted to the Village of Bellows Falls, Vermont, and in 1963, to the town of Charlestown, New Hampshire, for construction of wastewater treatment facilities. In 1964, land was deeded to the state of Vermont for construction of Interstate Highway 91. Land has also been leased to the state of Vermont since 1965 for a waterfowl nesting area adjoining Bellows Falls reservoir, and in 1964, land on the reservoir was deeded to the state of Vermont for boat launching and docking facilities.

The original license expired on June 30, 1970. The Project operated under annual licenses until the license was renewed on August 3, 1979. The 1979 license remains in effect and expires on April 30, 2018.

On October 5, 1978, FERC approved a settlement agreement concerning fish passage facilities for American shad and Atlantic salmon at the Project, and at two other projects - Wilder (Project No. 1892) upstream, and Vernon (Project No. 1904) downstream. The settlement was executed on December 30, 1977, among the Licensee, the States of Massachusetts, Connecticut, New Hampshire and Vermont, US Fish and Wildlife Service (FWS), and four non-governmental organizations (the Environmental Defense Fund, the Massachusetts Public Interest Research Group, Inc., For Land's Sake, and Trout Unlimited). The settlement called for staged design, construction and operation of passage facilities at the three Projects, with Bellows Falls' construction schedule being dependent upon a trigger number of 30 returning adult salmon to the downstream Holyoke Project (Project No. 2004). The upstream fish way was subsequently completed and commenced operation in 1984.

On July 26, 1990, the Licensee entered into a Memorandum of Agreement with the Connecticut River Atlantic Salmon Commission (CRASC) for permanent downstream fish passage facilities for the Wilder, Bellows Falls and Vernon Projects. A downstream fish diversion boom was installed in 1996, and passage is provided via the forebay sluiceway/skimmer gate, and by a supplemental sluice pipe.

On February 27, 1998, FERC approved the transfer of the license from New England Power Company to USGen New England, Inc. Under a multi-license amendment dated November 19, 1998, regional electrical transmission facilities were removed from the Project including three multi-wound step-up transformers. At that time, the station was automated and began operations via remote control from the Connecticut River Control Center in Wilder, Vermont.

On January 21, 2005 FERC Approved a change in the Bellows Falls Project Boundary, which removed a small piece of land with an office building (presently the TransCanada North Walpole office) from the Project. On January 24, 2005, FERC approved the transfer of the license to TransCanada Hydro Northeast Inc. On February 5, 2005, FERC approved another Project Boundary change, which removed 8.8 acres and historic structures from the Project boundary to facilitate subsequent transfer to the Bellows Falls Historical Society.

2.3 PROJECT FACILITIES

2.3.1 Existing Facilities

The dam is a concrete gravity structure extending across the Connecticut River between Rockingham, Vermont and Walpole, New Hampshire. Virtually all of the dam structure is located in New Hampshire. It is 643 feet long with a maximum height of about 30 feet, and is divided by concrete piers into 5 bays. Two bays contain steel roller-type flood gates and the three other bays contain stanchion flashboards. A steel bridge runs the length of the dam for access and for operation of flashboards. A 25-ton gantry crane sits atop the bridge. Figures 2.3-1 and 2.3-2 and table 2.3- 1 below provide additional detail.

Figure 2.3-1. Bellows Falls dam.

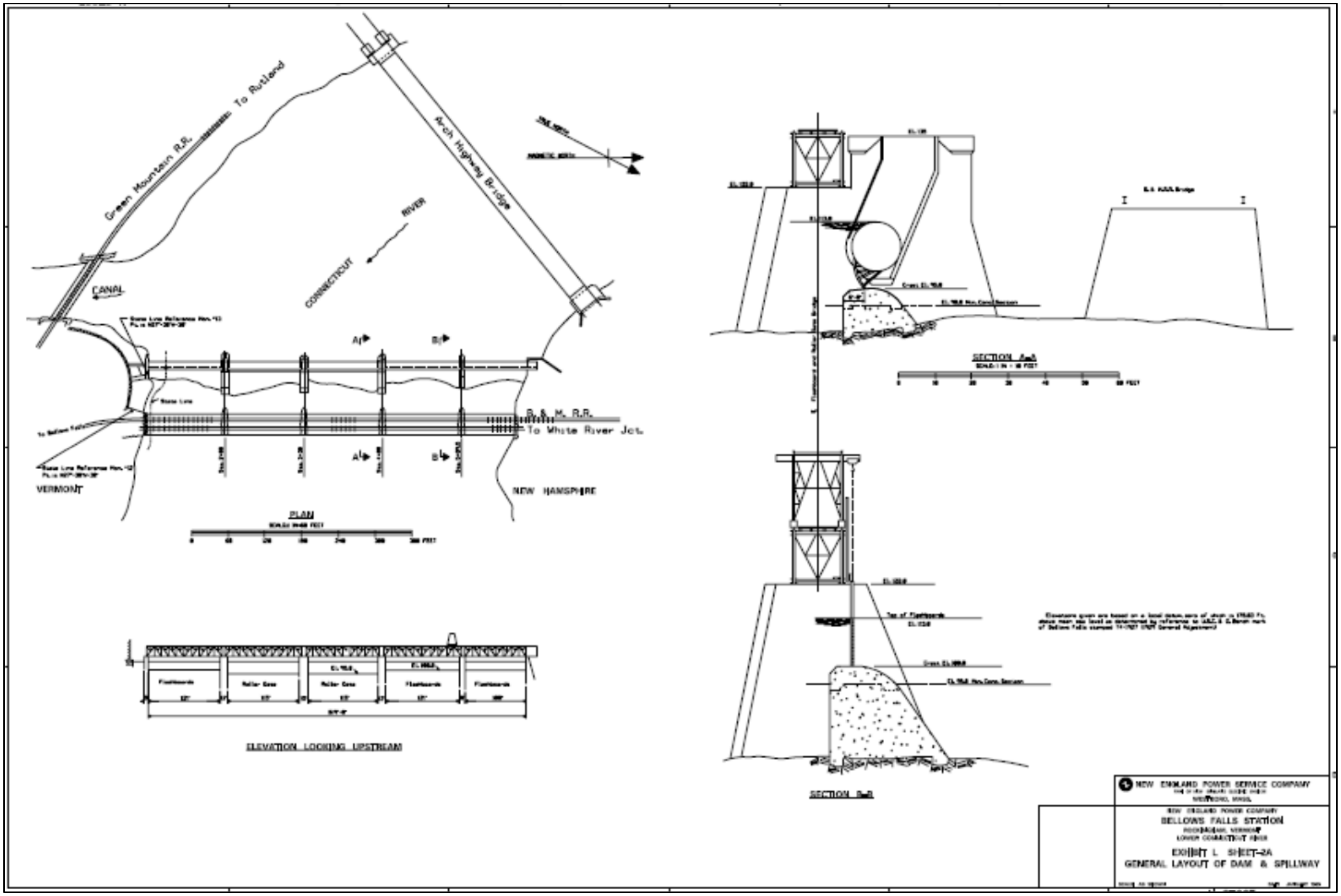

Figure 2.3-2. Dam and spillway.

Table 2.3-1. Spillway features.

Gate Type	Number	Size (height or width, by length in feet)	Elevation
Roller gates	2	18 x 115	273.63 (crest)
Stanchion bays	2	13 x 121 with flashboards	273.63 (crest)
Stanchion bays	1	13 x 100 with flashboards	278.63 (crest)

2.3.2 Canal Features

A power canal connects the reservoir to the powerhouse. The canal is lined with paving stones stabilized by a grid of concrete grade beams and walls. The downstream end of the canal is a concrete walled forebay. The canal is 100 feet wide at the top, about 36 feet wide at the bottom and about 29 feet deep, and approximately 1,700 feet long including the length of the powerhouse forebay. The canal creates a natural bypassed reach between the dam and the outlet of the powerhouse tailrace (see figure 2.1-1 above). The reach is about 3,500 feet long and receives minimal water from leakage, and when conditions dictate, spill from the dam. Figures 2.3-3 and 2.3-4 below illustrate the canal layout.

Figure 2.3-3. Bellows Falls canal.

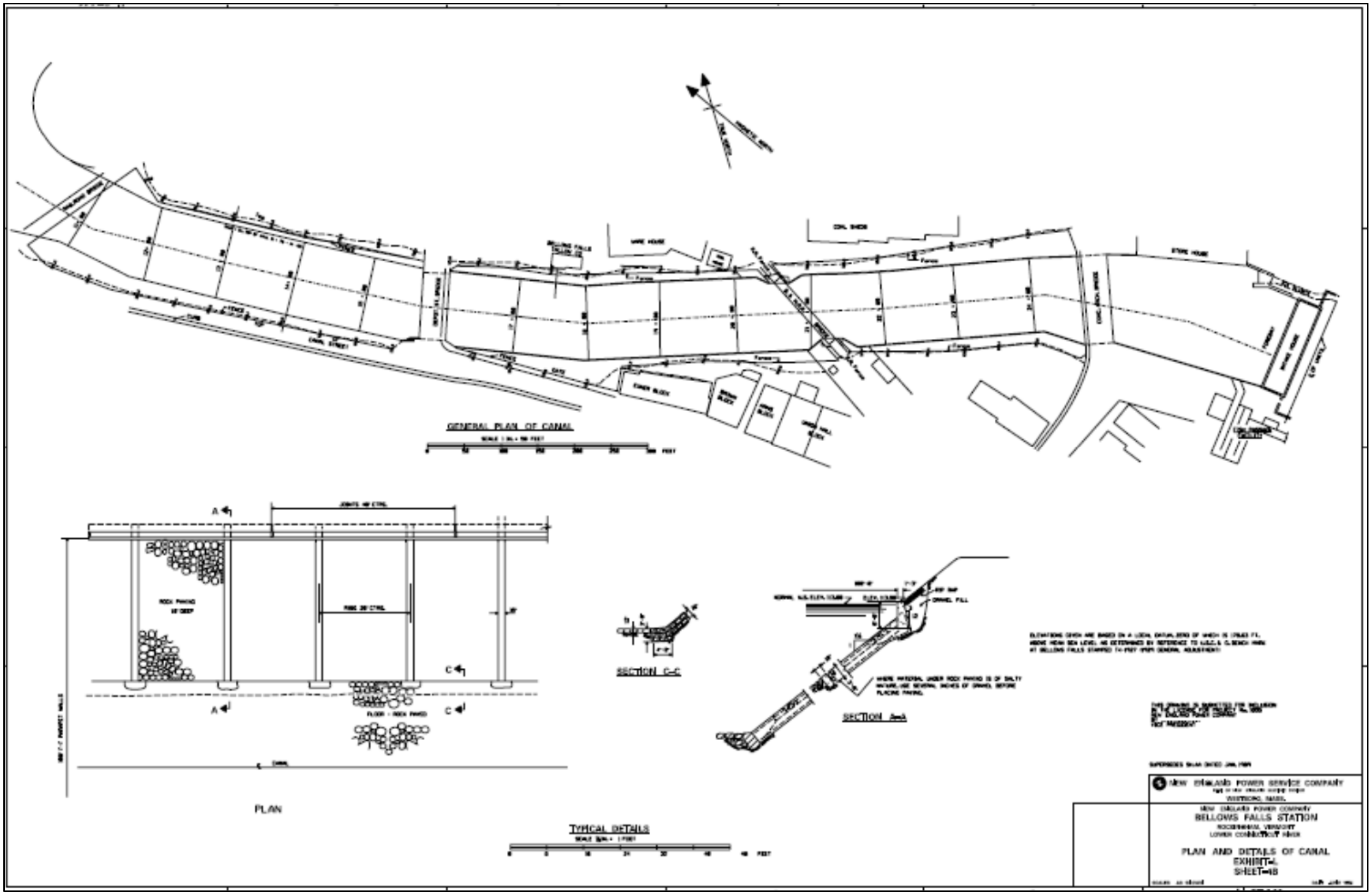

Figure 2.3-4. Canal layout.

2.3.3 Powerhouse Features

The powerhouse contains three turbine/generators, electrical equipment, a control room, machine shop, excitation equipment, emergency generator, air compressor, an overhead crane, offices, storage rooms, battery room and appurtenant facilities. The powerhouse superstructure is 186 feet by 106 feet by 52 feet, and constructed of steel frame and brick. The powerhouse substructure is of reinforced concrete construction excavated into bedrock.

The concrete gravity intake is integral with the powerhouse structure with two water passages for each of the three generating units. Water enters directly from the canal intake and into the scroll or wheel cases. The draft tubes discharge into the tailrace excavated partly in the bank and partly in the bed of the river. The generating units do not have draft tube gates. The scroll cases and draft tubes are formed in the concrete of the substructure which was poured on rock. The water passages for the three generating units have trashracks (4-inch clear spacing) and two headgates that can be used in any one of the three units. The headgates are equipped with an electrically driven hoist that can be moved along a track system to any of the three units as needed. A hydraulic "rack rake" is used to pull river debris away from the unit intakes. It is manually operated and is driven to the trashracks in front of each unit on a set of tracks that are located on top of the forebay intake structure. The rake head is lowered to the bottom of the racks and retracted upward along the rack to remove debris. The debris is conveyed into a trailer for removal.

An ice sluice/skimmer gate is located on the east side of the forebay and is 12 feet wide by 10 feet high. The tailrace is about 900 feet long, of which 500 feet is through rock. Figures 2.3-5, 2.3-6, and 2.3-7 and table 2.3-2 below provide additional details.

Figure 2.3-5. Bellows Falls powerhouse.

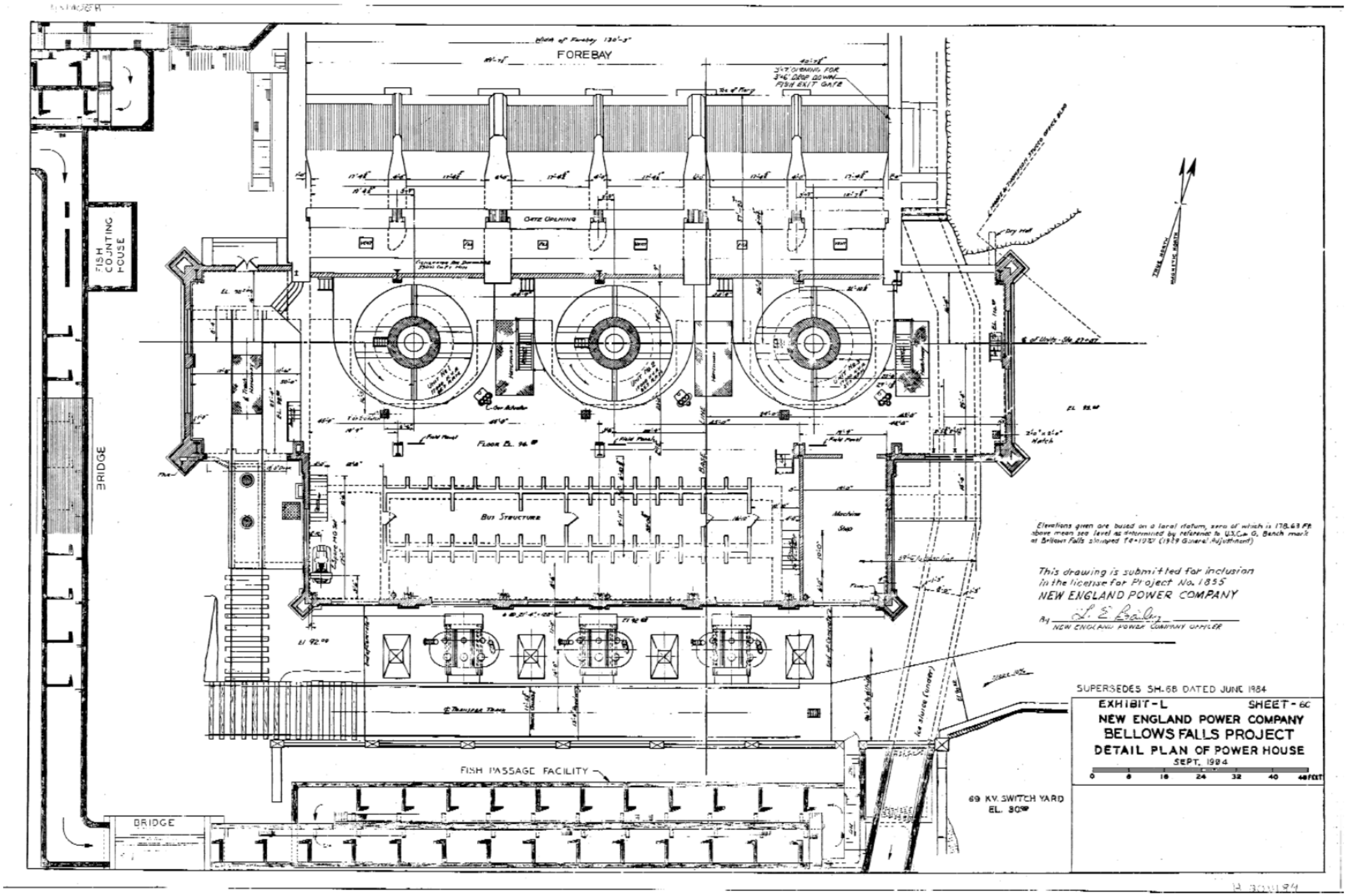

Figure 2.3-6. Powerhouse layout.

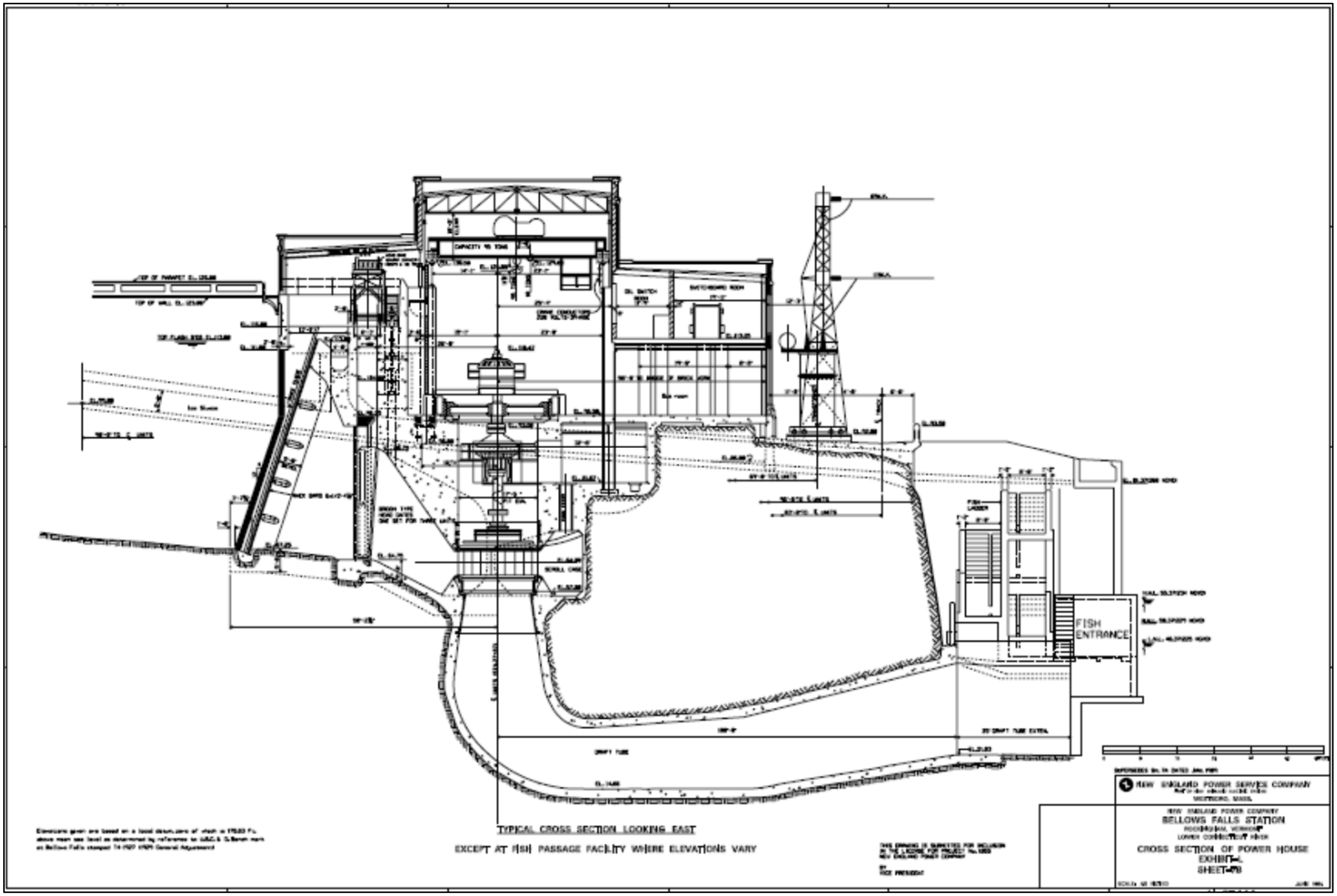

Figure 2.3-7. Powerhouse cross section.

Table 2.3-2. Project turbines and generators.

Unit Nos.	**1, 2, 3**
Turbines	
Type	vertical Francis
Design Head (feet)	57
HP Rating at Design Head	18,000
RPM	85.7
Min. Hydraulic Capacity (cfs)	~ 1,300
Max. Hydraulic Capacity at Design Head (cfs)	3,670
Intake Trashrack Size	4-1/2 inch on center
Generators	
Nameplate KVA	17,000
Nameplate KW	13,600
Power Factor	0.8
Phase/Frequency	3/60
Voltage	6,600

All three units (shown in figure 2.3-8) have direct connected main exciters as well as spare motor-generator excitation for the plant. The powerhouse contains a switchboard and control room used as a backup facility to the Connecticut River Control Center located at a separate facility at the Wilder Project.

Figure 2.3-8. Generators.

Project electrical facilities include the generators, generator terminals that extend from the powerhouse to an outdoor substation located west of the powerhouse, switchgear, bus work and two step-up transformers located in the substation. There is a 115 KV interconnection that provides power to two other switchyards and associated equipment located inside two fenced areas adjacent to the powerhouse.

The switchyards lie within the Project boundary but are not Project facilities because this equipment is owned and operated by one of the regional transmission companies, New England Power Company (NEP), d/b/a National Grid. NEP also owns three older transformers located outside along the south wall of the powerhouse. These transformers have reached their end-of-life date and will be removed. TransCanada has installed two new transformers in the new substation. The two new transformers and substation are not yet fully operational and have not yet been added to the Project facilities through a non-capacity license amendment (pending at this time). The new units will reduce the potential for arc flash and fire or explosion near the powerhouse, contain less oil than the old units, are equipped with secondary containment and oil/separation devices, and are located away from the river, thus reducing oil spill and oil contamination potential. Because the new units are not fully operational at this time, the Project continues to rely in part on the existing NEP equipment.

Controls for the 46 KV, 69 KV and 115 KV lines and for the outdoor switchyards are also owned by NEP and are located inside the powerhouse. Figure 2.3-9 illustrates the current separation of electrical facilities between the Project and NEP's facilities. At the completion of NEP's transmission upgrade project, all of NEP's equipment and controls will be located in the two switchyards.

2.3.4 Fish Passage Facilities

Upstream Fish Passage - Ladder Operation

The upstream fishway system consists of a conventional vertical slotted weir fish ladder at the powerhouse and an upstream concrete barrier dam in the bypass reach. The barrier dam prevents upstream migrating fish from being attracted by spillway discharge into the reach and later becoming trapped in isolated pools after spill ends. The barrier is located just upstream of the Boston and Maine railroad bridge.

The fish ladder (see figures 2.3-10 and 2.3-11) is a 920-foot long reinforced concrete structure with accessory electrical, mechanical and pneumatic equipment that was designed to provide passage for migrating Atlantic salmon and American shad past the dam by way of the forebay and canal, a vertical distance of about 60 feet. Upstream migrating fish are attracted to the tailrace channel by flow from the turbines. Once in the tailrace area, fish are attracted to the main entrance weir at the east end of the powerhouse. Attraction water is provided by the upper three weirs containing slide gates, which open and close depending on the forebay elevation to maintain the required fish ladder flow. A skimmer gate/sluiceway is located in the forebay and is used for additional fish ladder attraction water. Water from this channel enters two diffuser openings at the fish ladder entrance.

Fish enter the 8-foot wide fish ladder entrance channel and "climb" to the forebay by swimming through a series of 67 slots and cascading pools with each succeeding weir spaced 8 feet apart and 12 inches feet higher than the last.

After passing 34 pools, the fish enter a level turning section and pass through another 10 pools to the counting/trapping area. There, fish are guided by flow and crowder screens, travel through a 3-foot wide flume, and pass an underwater viewing window where they may be observed and counted. From the counting/trapping area, fish continue to climb through an additional 22 pools to the ladder's 8-foot wide exit channel into the forebay and canal. The exit channel (i.e., the last pool) includes a motor driven headgate, trashracks with 12 inch spacing, and slots for wooden stop logs.

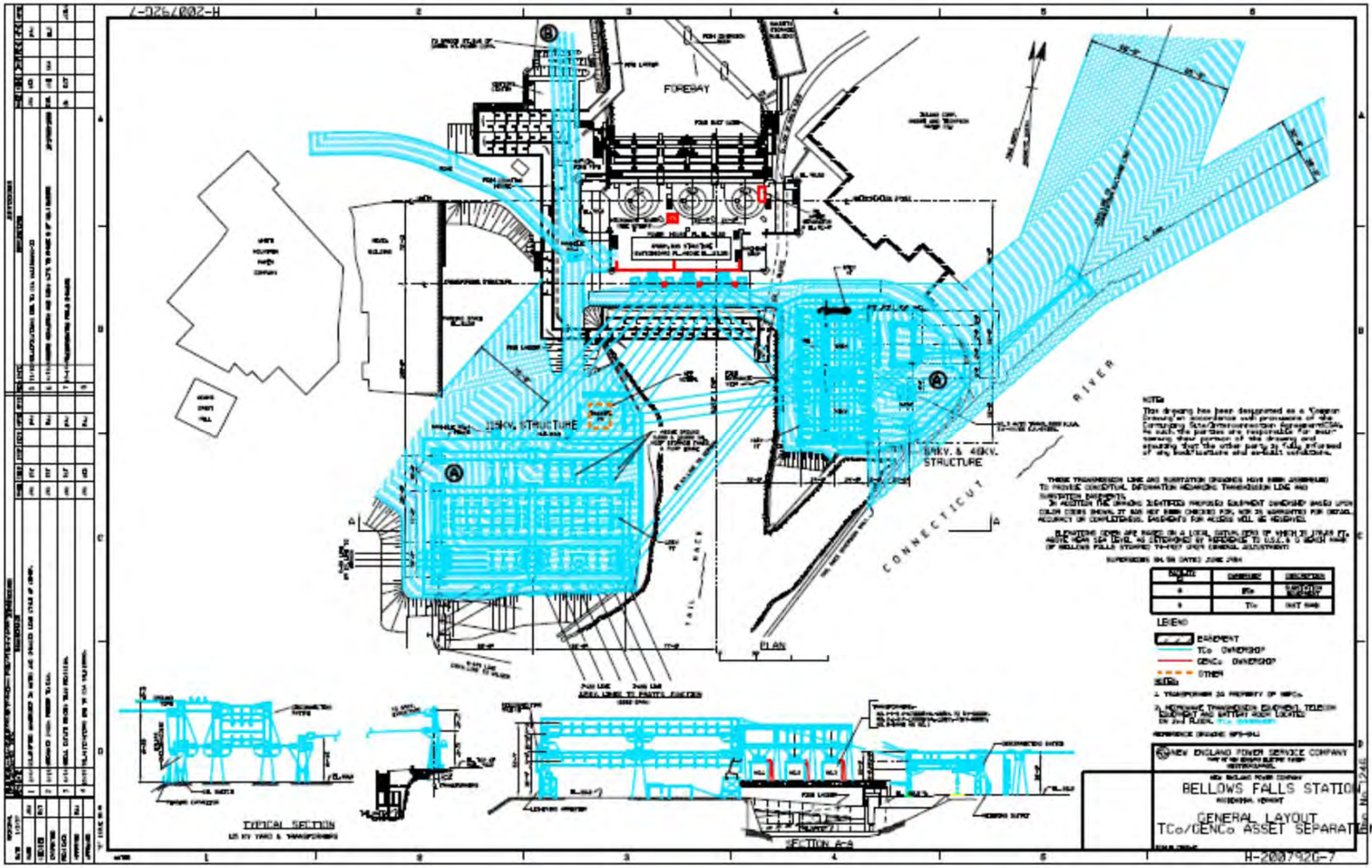

Figure 2.3-9. Project transmission interconnection with non-project transmission grid (red is project facilities).

Figure 2.3-10. Fish ladder.

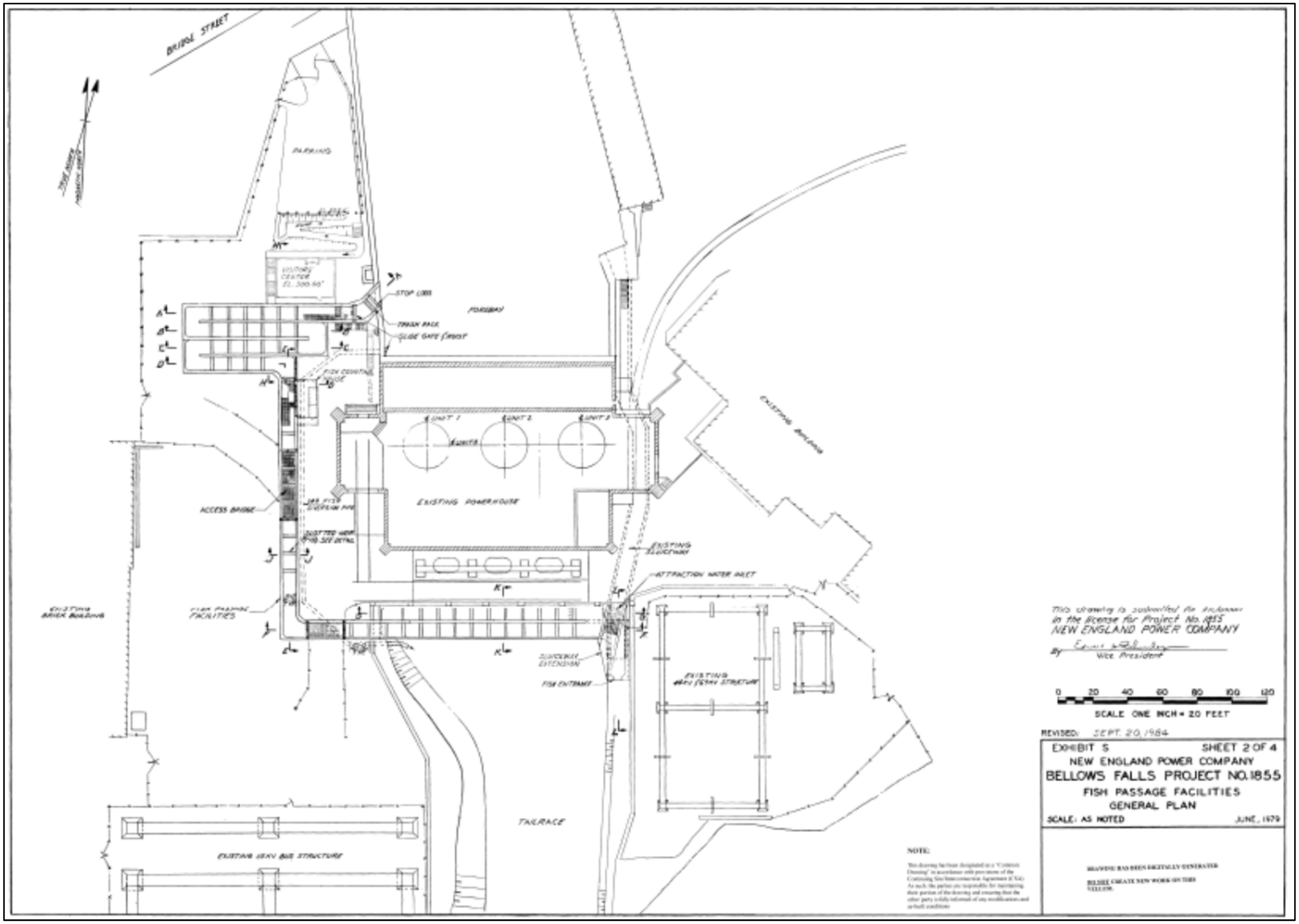

Figure 2.3-11. Fish ladder layout.

The last three weirs contain adjustable weir gates which can be lowered (opened) to provide a nearly constant 25 cubic feet per second (cfs) fish ladder flow when the forebay elevation drops through its 3-foot operating range.

The fishway's visitor center is located adjacent to the upper two pools and exit channel. The building's basement serves as a public viewing gallery with two underwater windows. The upper floor provides informational displays on hydro generation, recreation, archeology and anadromous fish restoration; and has a picture window view of the fish ladder to the south (downstream).

The operating season of the fish ladder has been determined by the schedule provided each year by the Connecticut River Atlantic Salmon Commission (CRASC). The ladder operates annually during the spring and fall seasons. In the spring, migration has typically not started before May 15th and has run through July 15th. In the fall migration season, although generally specified as between September 15th and November 15th, the ladder has typically not operated until there was evidence that a salmon was located immediately below the Project. To date, all Atlantic salmon released into the Connecticut River at the Holyoke fish lift have had a radio tag implanted in them by TransCanada contractors with concurrence from state and federal agencies in order to track their migration in the river basin.

Upstream Fish Passage - Entrance Attraction Water

The attraction water system supplements the 25 cfs fish ladder flow water and is provided from the forebay via the ice/debris sluice located along the east side of the powerhouse. Attraction water is introduced through floor and sidewall diffusers in the fish ladder entrance structure, where it drops through a floor grating into the attraction water chimney structure where flow to the diffusers is controlled by two sluice gates near the chimney base east of the No. 3 draft tube. A total of 80 cfs is used for attraction and fishway flows.

Upstream Fish Passage – Effectiveness Evaluations

No formal effectiveness studies have been performed on the fish ladder due to the lack of returning adult Atlantic salmon to the Connecticut River basin overall, and in particular because of the small number of adults passing the Vernon dam and arriving at the base of Bellows Falls dam.

However, Vermont Fish & Wildlife and Normandeau have monitored adult Atlantic salmon utilization of the Bellows Falls fish ladder since 1998. Overall, 31 tagged salmon (21 percent of the total 146 tagged) used the fish ladder at Bellows Falls. Fifty percent of all tagged salmon that passed Vernon dam also passed upstream of Bellows Falls (see section 3.6, *Fish and Aquatic Resources* for more information). Note that this is not an indication of passage effectiveness as Atlantic salmon that pass Vernon dam may migrate up key tributaries below the Bellows Falls dam, such as the West River.

Downstream Fish Passage - Operation

Downstream migrating fish are attracted to the forebay sluiceway/skimmer gate by a solid, partial depth diversion boom across the canal. A small auxiliary gate located on the east side of the powerhouse is opened to direct fish that may get under the diversion boom to the sluiceway.

The operating season for downstream passage has been determined by the schedule provided each year by the CRASC. Downstream passage operates annually during the spring and fall seasons. In the spring, it is used primarily to facilitate downstream movement of juvenile Atlantic salmon smolts, and has been typically opened from April 1 through June 15 each year. The fall season was specified by the CRASC as being from October 15 to December 31 for adult Atlantic salmon movement to final spawning habitat. In practice, due to the fact that adult Atlantic salmon locations are monitored, the CRASC has not required opening the downstream passage unless an adult is present immediately above the dam. Radio antennas and receivers are deployed each year above and below the dam to monitor the presence of tagged adult Atlantic salmon and to confirm their passage.

Downstream Fish Passage – Effectiveness Evaluations

Behavior and movement studies of Atlantic salmon smolts at the Project were conducted in 1991 and 1992. These studies evaluated the capability of the existing ice/debris sluice to provide safe and effective passage. The study found that a disproportionate number of smolts passed through the turbines instead of using the bypass. In 1994, radio transmitter tagged smolts released for a Wilder Project study were also monitored at Bellows Falls to evaluate downstream passage. Passage success was not favorable and in response, plans were initiated to construct a diversion boom in the forebay of the powerhouse to divert emigrating smolts to the ice/debris sluice bypass. In 1995, another radio telemetry study was conducted to determine the effectiveness of the new diversion boom. This study indicated a high passage rate and high survival (see section 3.6, *Fish and Aquatic Resources* for more information).

2.3.5 Ancillary Buildings and Recreation Facilities

Line Garage

This structure houses maintenance equipment necessary to maintain exterior components of the Project (e.g., mowing equipment, recreation area and public safety equipment).

Baukets Storage Building

This structure houses miscellaneous equipment, construction materials, vehicles and the forebay bubbler air compressor.

Recreational Facilities

- Herrick's Cove boat launch and recreation area
- Charlestown lower landing boat launch and picnic area
- Pine Street boat launch and portage trail take-out
- Walpole portage put-in
- Bellows Falls visitor center and fish ladder

These facilities and other recreational opportunities in the Project vicinity are discussed in section 3.10, *Recreation and Land Use*.

2.3.6 Project Boundary and Land

The Project extends 26 miles upstream on the Connecticut River in both New Hampshire and Vermont. The Project boundary includes the powerhouse, canal and dam, the impounded portion of the river, a limited amount of fee-owned project land, and a significant quantity of private lands adjacent to the river upon which TransCanada retains flowage rights to operate the Project. In general, flowage rights provide TransCanada with the ability to flow on and otherwise affect the lands and properties of others due to the construction, maintenance and operation of the Project to an elevation not to exceed 291.6 feet above sea level at the Bellows Falls dam. Flowage rights are tied to property and often are associated with entire parcels despite their reference to the water's edge. The Project boundary as described by TransCanada is the extent of the inundation limit at normal operation. The extent to which lands with flowage rights retained by TransCanada are affected by water due to project operation or natural inflow is largely determined by the elevation of the land in relation to the elevation of the river (surface water elevation). Surface water elevation can be affected by three considerations: 1) surface water elevation at the dam; 2) the quantity of inflow from upstream and intermittent sources; and 3) the distance upstream of the dam.

TransCanada owns 835 acres of land in the Project. Of this, 62 acres are used for plant and related facilities; 86 acres for public outdoor recreational use; 60 acres have been set aside as natural lands; and the remaining 627 acres support local agriculture, farming, and wildlife management. Detailed Project maps are provided in attachment 1 to this PAD.

2.3.7 Proposed Facilities

No new facilities are proposed at the Project; however, as opportunities arise to examine upgrades and efficiency gains, TransCanada has and will continue to evaluate them in the ordinary course of its business.

2.4 PROJECT RESERVOIR

The Project includes a 26-mile impoundment which extends upstream to Chase Island at Windsor Vermont, about one mile below the Windsor Bridge.

The reservoir has a surface area of 2,804 acres and about 74 miles of shoreline. The reservoir has a total volume of 26,900 acre-feet at normal pool elevation (El.) of 291.63 feet at the top of the stanchion boards. The usable storage amounts to about 7,476 acre-feet in three feet of drawdown to El. 289.63; however, maximum usable storage is about 9,568 acre-feet in four feet of drawdown to El. 288.63. The typical reservoir operating range is between El. 291.4 and 289.6. Figures 2.4-1 and 2.4-2 illustrate reservoir conditions at various elevations.

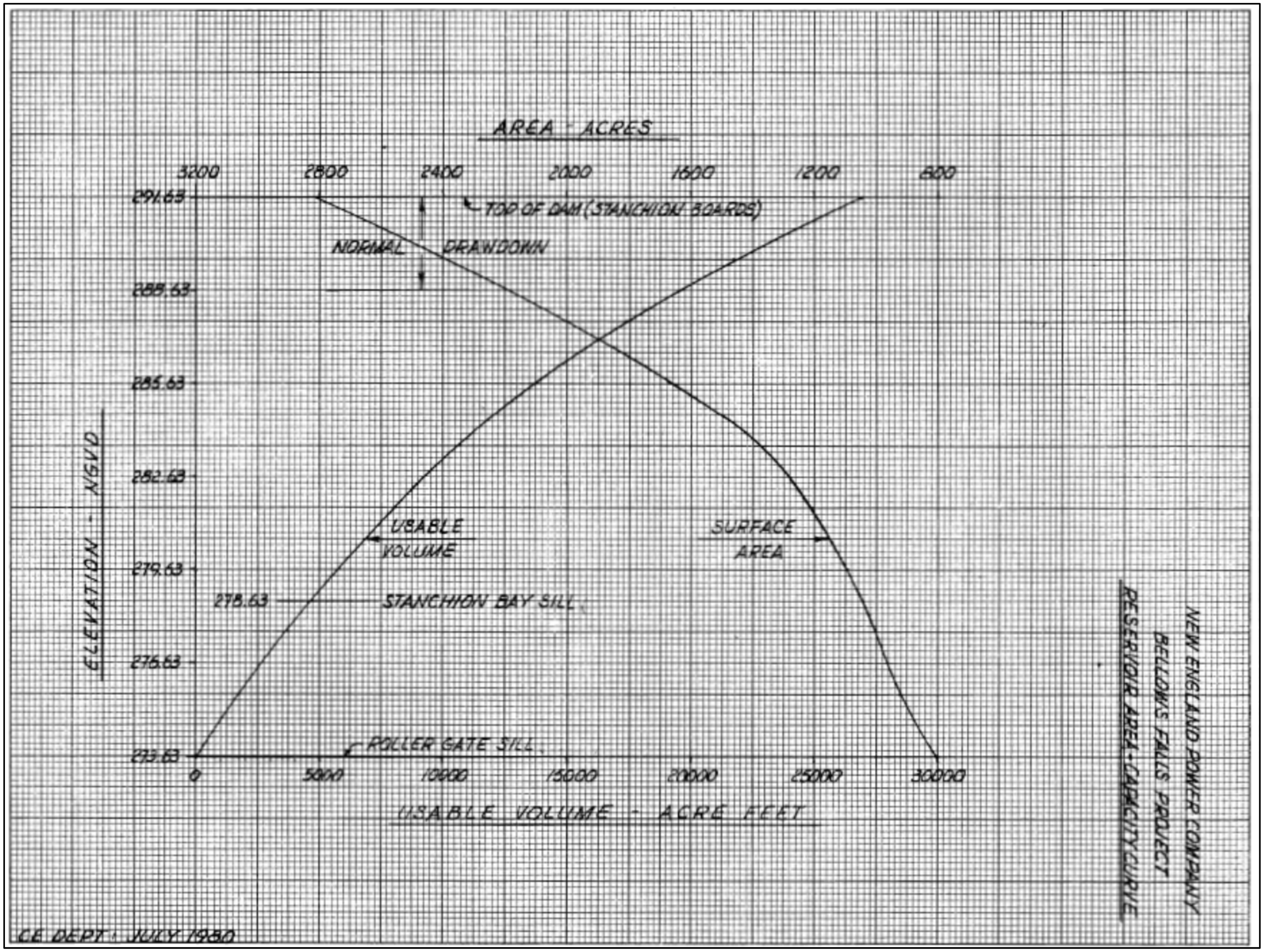

Figure 2.4-1. Reservoir capacity curve.

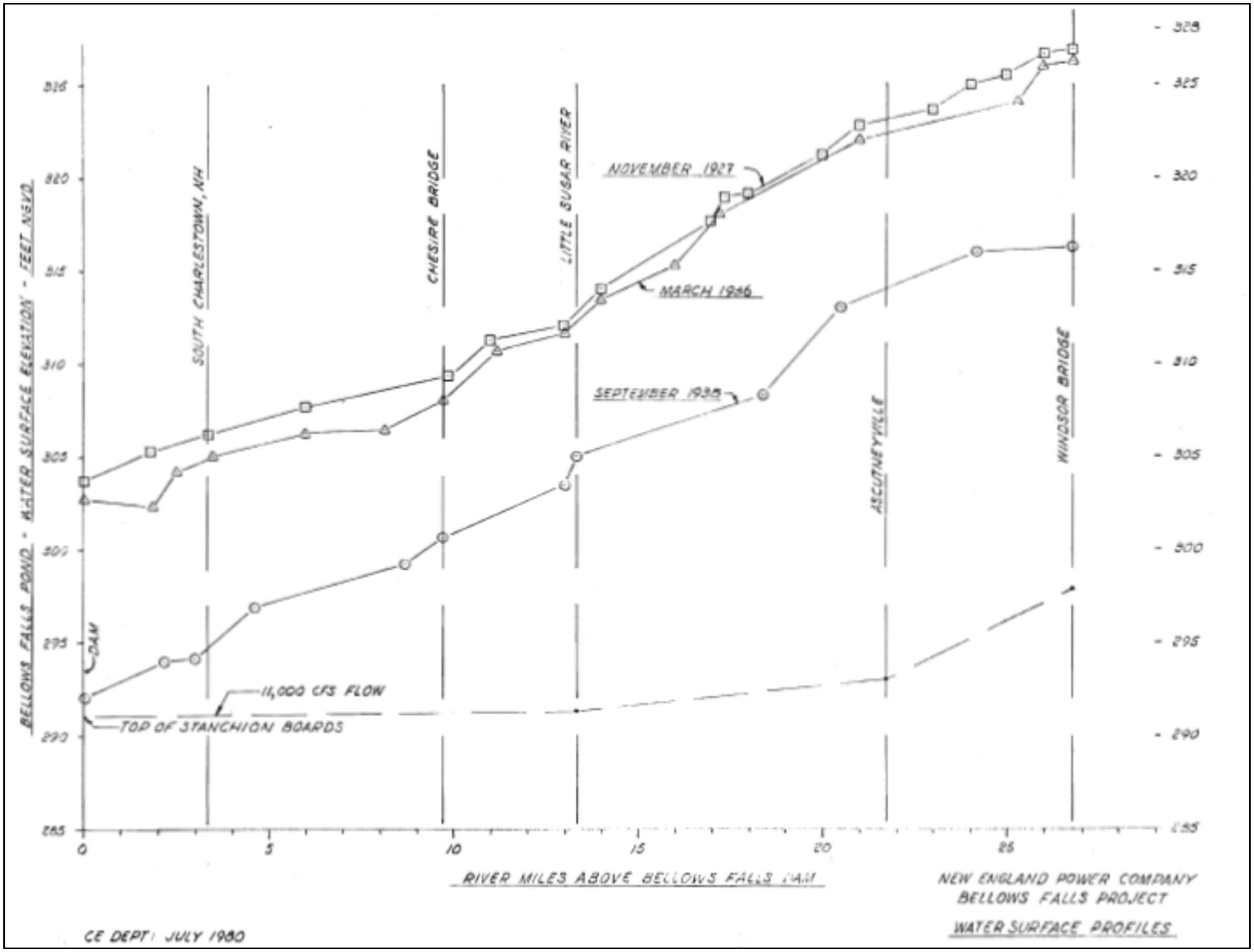

Figure 2.4-2. Water surface profiles.

Reservoir drawdown rates are typically less than one or two-tenths of a foot per hour and do not exceed three-tenths per hour based upon a self-imposed restriction. There is approximately 3,000 cfs per hour per 0.1 feet of elevation.

Due to a number of factors including the overall length of the reservoir, the range of potential inflow in relation to generation discharge capacity, and the reservoir slope variability based upon inflow and constricted topography in particular locations, the Project operates in a “river profile” manner once flows exceed station capacity. See section 2.5, *Current Project Operations* below for more detail.

During the summer recreation season, beginning the Friday before Memorial Day, through the last weekend in September, TransCanada maintains a self-imposed minimum reservoir elevation of 289.6 feet from Fridays at 4 pm through Sundays at midnight and similar hours for holidays during this period.

2.5 CURRENT PROJECT OPERATIONS

2.5.1 Basin Information

The drainage area above the dam is 5,414 square miles. Flows in this reach of river are influenced by the discharge from upstream hydroelectric projects under normal flow conditions. Approximately 2,039 square miles of intermediate drainage area provides natural inflow into the Project beyond what is released from the upstream Wilder Project. Main tributaries include the White River, Ottauquechee River, Black River and Williams River in Vermont, and the Mascoma River and Sugar River in New Hampshire. See section 3.3, *River Basin Description* for more detail.

2.5.2 Normal Operations

The Project is operated in conjunction with other TransCanada hydroelectric generating facilities on the Connecticut River, taking into consideration variations in demand for electricity as well as natural flow variations due to seasonal snow-melt or precipitation events that occur within the Connecticut River watershed. The Project is operated primarily on a daily run-of-the-river basis, meaning generally that over the course of a day, its operation passes the average daily inflow. Figure 2.5-1 below illustrates the relationship between hydroelectric facilities on the river.

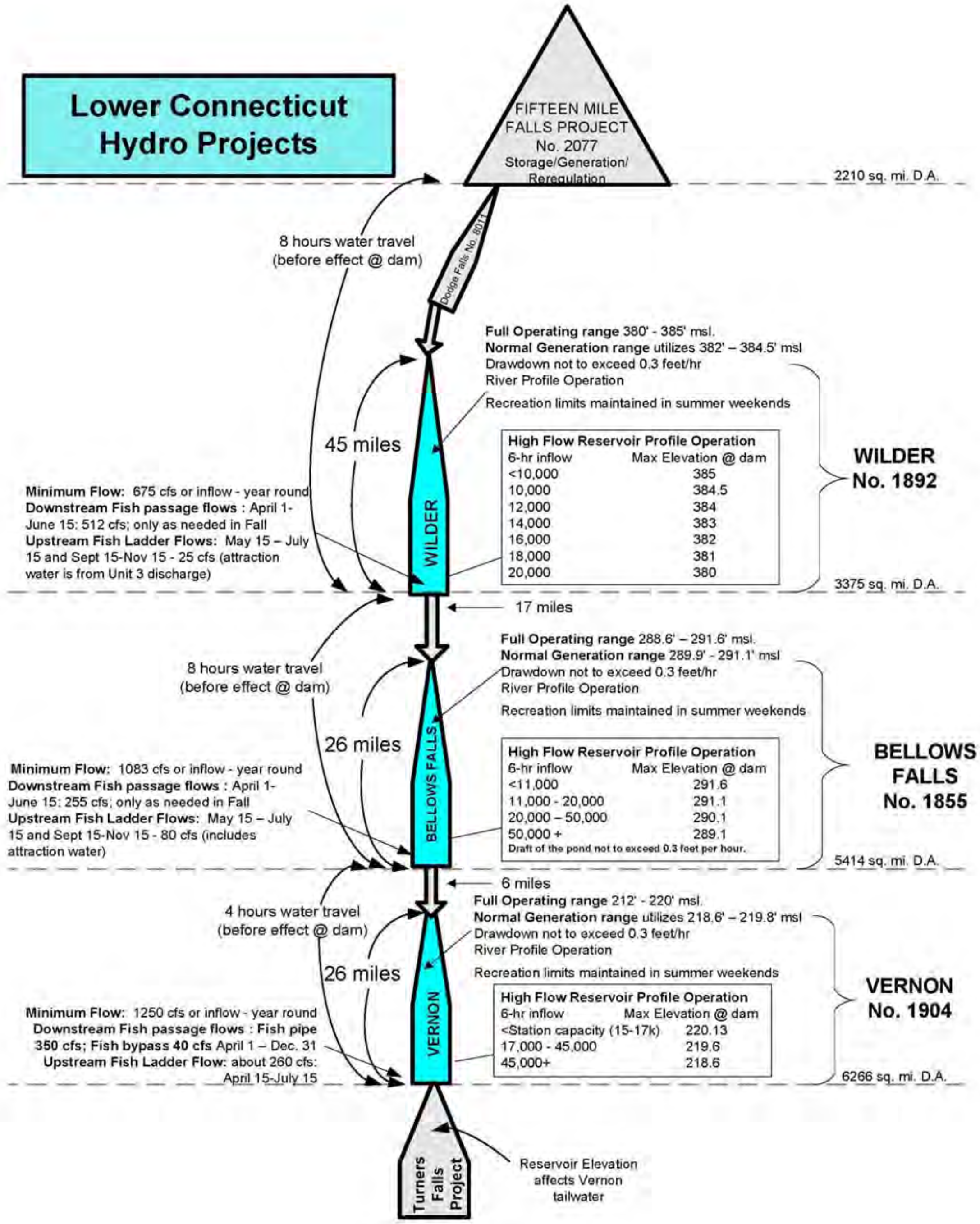

Figure 2.5-1. Connecticut River operations summary.

During periods when average daily flows are less than maximum station flow capacity, the Project uses the limited daily storage in the impoundment to dispatch generation as required to meet the generation schedule managed by the New England Independent System Operator (NE-ISO). Generation can vary during the course of any day between the required minimum flow and full capacity, if higher flows are available.

During periods of sustained high flows, Project generation is dispatched in a must-run status in order to utilize available water for generation.

A constant 1,083 cfs minimum flow (or inflow) is required through the powerhouse. Minimum flow is provided primarily through generation at a minimum efficient operating flow of about 1,300 cfs. There is no minimum flow requirement through the dam into the bypass reach.

2.5.3 Inflow Calculation

Inflow into the Project is from two generalized sources: 1) discharge from the Wilder Project located about 43 miles upstream; and 2) natural inflow from the 2,309 square miles of intermediate drainage area below Wilder. Flow information from these two sources is used to calculate the flow expected to reach the dam six to eight hours later.

Estimated inflow is calculated and used to schedule operation of generators, predict and determine pond elevation, and determine gate and stanchion bay operation if required to pass excess flow. Eight to twelve hours in advance, Project inflow is estimated by combining the discharge from Wilder and two times the flow at the USGS gage on the White River at West Harford, Vermont. Inflows are typically calculated on an hourly basis. Inflow less than the required 1,083 cfs minimum is typically not determined since the generator(s) used are designed to operate at a minimum efficiency of about 1,300 cfs.

The Bellows Falls reservoir can be pre-drawn in advance of the inflow (between El. 291.6 and El. 289.1), but only to the extent that the inflow will utilize the limited storage made available without requiring spill. Operating impoundment elevation limits must be set for the reservoir in preparation for any spillway gate operation. Elevations at the dam are reduced as inflows increase above 11,000 cfs.

2.5.4 River Profile Reservoir Operation

When inflow into the Bellows Falls reservoir increases above 11,000 cfs operators will initiate “river profile” operation by lowering the elevation at the dam. There are three stages to the river profile operation corresponding to inflows above 11,000 cfs that have been established in order to operate the reservoir at elevation 289.1 when inflows exceed 50,000 cfs, as shown in table 2.5-1.

Table 2.5-1. River profile operating stages.

Anticipated Inflow	Maximum Elevation at the Dam.
< 11,000 CFS	291.6
11,000 – 20,000 CFS	291.1
20,000 – 50,000 CFS	290.1
> 50,000 CFS	289.1

2.5.5 High Flow Operation

High flows, meaning flows above station capacity that require spill gate operation, occur at the Project routinely throughout the year. Annually, flows at the dam exceed station capacity approximately 31 percent of the time. There is little flood storage capacity within the Project. 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. Drawdown is limited to no more than 0.3 foot per hour (about 9,000 cfs per hour) and is generally kept within the 0.1 - 0.2 foot per hour range. Pre-spilling to create storage capacity does not generally occur at Bellows Falls. The timely anticipation of high flows within operational constraints can minimize or eliminate spill, resulting in the best use of the water resource.

Operations at the upstream Fifteen Mile Falls Project (FERC No. 2077) are coordinated to reduce spill at all three downstream Projects, Wilder, Bellows Falls and Vernon, by capturing inflow. High flows resulting in spilling at these three projects, collectively referred to as the Lower Connecticut projects, are typically independent of upstream hydroelectric operation and are a result of natural inflows below Fifteen Mile Falls.

Spring runoff on the Connecticut River typically occurs in phases based upon latitude. For example, normal spring runoff at the Project occurs distinctly earlier than runoff above the Wilder Project but below the Fifteen Mile Falls Project. The spring run-off from the Connecticut Lakes down to Fifteen Mile Falls occurs even later in the season. The seasonal storage capability of the Fifteen Mile Falls Project is limited in comparison to the total amount of inflow it receives. The storage capacity at that project is utilized during spring runoff to capture the anticipated peak inflow and refill the project reservoirs, reducing potential downstream high water conditions at the Wilder Project and further downstream. The Lower Connecticut projects are typically spilling water as the upstream storage is capturing its peak inflow to the extent possible.

During periods of ice movement, frequent upstream observations and river elevation checks are made within the reservoir area. When there is an ice jam immediately upstream of the dam, an increased or artificial inflow condition is created by a large swell of water in front of the jam as the water behind the jam pushes the ice and water in front of it. When this condition occurs, the station or roller gate discharge must be increased to pass this temporary situation and to keep the reservoir elevation within its operating pond limits because there is no reservoir storage capacity in this circumstance.

The Project spillway was designed to have a discharge capacity of approximately 120,000 cfs at normal full pond level, and it successfully passed flows up to the maximum flood of record, 156,000 cfs in March 1936. Since the 1936 flood, the US Army Corps of Engineers (USACE) has constructed flood retention reservoirs throughout the Connecticut River basin, which substantially reduce the probability of floods of such magnitude. Station and spill capacity are provided in table 2.5-2.

Table 2.5-2. Station discharge capacity.

Station Capacity (cfs)	No Spill	EL. 288.6	EL. 289.6	EL 290.6	EL. 291.6
3 generators	11,400	9,800	9,600	9,300	7,800
2 roller gates	0	44,300	49,000	53,800	58,800
Nos. 1 and 4 stanchion bays	0	24,700	28,660	32,840	37,200
No. 5 stanchion bay	0	10,160	11,800	13,500	15,290
1 forebay skimmer gate	0	310	425	555	695
Total Capacity	**11,400**	**89,270**	**99,485**	**109,995**	**119,785**

Spillway discharge at the dam is regulated by two roller gates and three stanchion bays as described in section 2.3.1 above. Each roller gate can be used as regulating gates and can be operated by local or remote control. Operating experience has shown that the gate aprons can receive considerable damage from ice and debris if operated at certain gate openings. For this reason gate operating limits have been set for remote control operation. The normal power source to operate the roller gates is from the station service supply. A diesel driven 100 KW generator located at the dam provides emergency power to the roller gates in case of power failure. The engine and generator are exercised weekly and used to open each of these gates prior to each spring freshet.

Stanchion removal does not take place until flows exceed 50,000 cfs. One or both roller gates are used and some stanchions can be removed to control the reservoir at El. 289.6. Stanchion beam removal is accomplished in accordance with the spillway operating procedure. A complete stanchion bay can be removed in 10 to 15 minutes, where the stanchion beams are released and later retrieved from the spillway channel area. Any portion of a bay (stanchion beams) can be released depending upon the flow conditions.

As stanchion sections are removed the second roller gate is closed to maintain a constant pond elevation and minimize downstream surge. Generation operation is reduced to compensate for the increased spill, thereby further minimizing downstream surges. Once flows reach 90,000 cfs the reservoir elevation is raised, both roller gates are fully opened and all stanchion bays are removed to maintain the reservoir at El. 290.6 as long as possible. As inflow continues to increase, generation operation is also increased. At approximately 115,000 cfs, flows exceed the Project's spill capacity. Table 2.5-3 provides a summary of the Project's high flow operation based upon increasing inflow from upstream and tributary sources.

Table 2.5-3. High flow operations summary.

Bellows Falls Natural Inflow	Project Status
11,000 cfs or less	Flows in this range can be passed through the station using the three hydro-turbines or less depending upon the schedule for load requirements. The 1979 License Article 35 requires a minimum flow of 1,083 cfs from the Project which is supplied through a hydro unit.
11,000 to 20,000 cfs	When flows exceed station capacity (11,400 cfs), all hydro units are wide open, a limit is placed on the pond elevation (river profile operation) to assure pond elevation of 291.1, and roller gates are operated as needed to pass the excess flow. The rate of draw or fill is determined to reach the desired elevation and the roller gates are used to maintain the pond elevation. The rate of draw is normally 0.1 to 0.2 foot/hour; however, under all circumstances the draw rate is not to exceed 0.3 foot/hour; equal to about 9,000 CFS. Pre-drawing the pond is only done in anticipation of short duration, expected inflows in order to mitigate spilling to the extent possible.
20,000 to 50,000 cfs	Inflows in this range require all units to be run wide open, a limit is placed on the pond elevation, and the roller gates are operated as needed to pass the excess flow. For this flow range, the pond limit is set at El. 289.6 if there is ice in the river or El. 290.1 if there is no ice. The roller gates are opened as required to maintain this elevation. The rate of draw is not to exceed 0.3 foot/hour under all conditions.
50,000 to 90,000 cfs	Inflows in this range require all units to be run wide open, a limit is placed on the pond elevation to El. 289.6, the first roller gate is opened wide and the second gate is operated as needed to control the pond elevation. One or more stanchion boards are removed as needed to control the pond elevation.
Expected to exceed	Inflows in this range require all units to be run wide open, both roller gates wide open, and the complete removal of all

Bellows Falls Natural Inflow	Project Status
90,000 cfs	stanchion bays. Pond elevation is held to 290.6 as long as possible. If flows exceed 115,000 cfs, flows exceed the spill capacity of the Project. Further inflow increases will raise the elevation at the dam and increase the spillway discharge.

2.5.6 Flood Control Coordination and Navigation

The USACE operates and maintains flood control dams on the Black River at North Springfield, Vermont and on the Ottauquechee River at North Hartland, Vermont. These two projects can capture the stream flow from the 378 square miles of drainage area above them, which contribute to flood flows into this portion of the Connecticut River and the Bellows Falls reservoir.

Per Article 32 of the existing license, an agreement with the USACE provides for the coordinated operation of the Project with the USACE dams, in the interest of flood control and navigation on the Connecticut River. It specifically describes the operating protocol associated with periods of high inflow in which the elevation at the dam is lowered. This is known as “river profile” operation to maintain upstream elevations within a range that protects specific railroad grade embankments along the river as well as reduces potential for river flows to spill outside the normal operating range.

2.6 EXISTING LICENSE AND PROJECT OPERATIONS SUMMARY

2.6.1 Energy Production

Claimed capacity of the Project is 48.54 MW. Average annual gross energy production over the last 30 years (1982-2011) was 242,829 megawatt-hours (MWH). Average monthly gross energy production over the same time period varies from a low generally of 11,020 MWH in September to a high of 28,074 MWH in April.

Project monthly and annual generation and discharge since 2000 is summarized in tables 2.6-1 and 2.6-2 below. It should be noted that precipitation was higher than normal during this period. Additional information is provided in section 3.5.2, *Hydrology*.

Table 2.6-1. Generation summary (MWH) 2000 – 2012 year-to-date.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2000	25,418	12,937	30,947	27,866	30,840	22,219	12,484	17,070	9,680	11,999	19,725	18,449	239,634
2001	18,459	14,965	14,879	23,586	25,129	20,829	12,276	4,470	4,648	5,038	8,251	11,798	164,328
2002	10,636	17,286	32,243	28,241	30,501	30,614	14,685	6,185	7,249	10,754	20,732	15,901	225,027
2003	14,033	10,313	16,168	30,280	29,103	18,774	10,011	17,632	12,103	19,392	21,875	21,132	220,816
2004	20,859	14,174	23,073	31,103	29,315	15,494	14,102	16,711	18,991	10,773	15,644	27,389	237,628
2005	24,769	14,401	17,124	27,171	32,186	27,707	17,668	7,238	11,566	24,120	29,879	27,309	261,138
2006	27,386	25,958	22,213	31,304	24,563	27,459	26,546	19,370	10,131	21,764	28,649	28,473	293,816
2007	29,974	14,011	21,954	28,720	29,678	16,949	18,266	9,952	8,959	18,245	27,179	26,433	250,320
2008	28,331	25,638	30,455	24,673	24,825	23,933	22,193	27,530	15,879	16,974	22,215	20,110	282,756
2009	18,473	17,249	30,119	29,306	28,140	22,806	30,671	25,771	10,039	20,816	28,931	28,255	290,576
2010	25,124	19,581	26,822	30,193	26,398	18,555	12,161	12,479	6,757	30,591	27,167	28,518	264,346
2011	20,602	14,268	27,789	25,535	29,755	25,971	11,969	13,978	22,769	29,338	21,841	28,793	272,608
2012 YTD	24,590	17,555	24,502	22,843	29,255	20,647	11,279	7,811	9,513				167,995
Average	22,204	16,795	24,484	27,755	28,438	22,458	16,485	14,323	11,406	18,317[a]	22,674[a]	23,547[a]	248,887

[a] average of 2000 – 2011 only

Table 2.6-2. Discharge summary (cfs) 2000 – 2012 year-to-date.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
2000	7636	5054	18143	29059	19214	7377	4075	5072	2970	3618	6079	10023	9860
2001	5159	4948	4637	31046	10651	7787	3642	1546	1578	1745	2706	3438	6574
2002	3279	5671	11594	25473	14344	13196	4643	1993	2181	3271	6185	5031	8072
2003	4159	3422	12461	18421	12590	6153	3509	6683	4372	11739	17058	18841	9951
2004	8572	4331	9227	18532	12354	6030	4584	5870	7914	3353	5527	10501	8066
2005	8360	4904	6272	30187	13354	12796	5447	2491	3793	22408	19904	13184	11925
2006	18386	12588	9182	12945	19138	18176	11296	6927	3391	13311	16125	12723	12849
2007	12615	4769	11256	27505	14563	5885	6003	3039	2770	7068	12177	8627	9690
2008	12569	9809	15423	37686	11622	8226	11259	16467	4731	7712	10573	14639	13393
2009	7848	6160	16477	22344	12155	8280	14194	9735	3558	10073	11291	12526	11220
2010	8774	7416	20170	18584	10126	6448	3963	4006	2295	18717	13073	12669	10520
2011	6370	4876	15568	35336	24369	9444	3534	10275	13450	13910	7400	11453	12999
2012	7622	5800	14348	9842	13912	8500	3259	2414	2883				
Average	8565	6134	12674	24382	14492	9100	6108	5886	4299	9744 [a]	10675 [a]	11138 [a]	10426 [a]

[a] average of 2000 – 2011 only

2.6.2 Net Investment

The Federal Power Act (FPA) generally defines a Licensee's net investment in a project as the original cost of the project, plus additions and betterments, minus depreciation and other amounts (16 USC § 796 (13)). TransCanada's net investment in the Project as of December 31, 2011, was $66,220,962. This amount is based on the allocated 2005 purchase price of the former USGen New England, Inc. hydropower assets plus net investments in capital improvements from 2005 to 2011.

2.6.3 Current License and License Amendment Requirements

In addition to standard Articles 1 through 28 set forth in Form L-3 (Revised October 1975) entitled "Terms and Conditions of License for Constructed Major Project Affecting Navigable Waters of the United States", the Project license includes the requirements summarized in table 2.6-3.

Table 2.6-3. Summary of license and amendment requirements.

License Article	Summary of Requirement
29	Requires establishment and maintenance of amortization reserves based on a specified reasonable rate of return upon the net investment in the Project.
30	Requires payment of annual charges to FERC for the cost of administration of the license, based on the authorized installed capacity for that purpose of 54,400 horsepower.
31	Requires implementing and modifying when appropriate, the emergency action plan on file with FERC 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.
32	Requires entering into an agreement with the USACE to provide for the coordinated operation of the Project, in the interest of flood control and navigation on the Connecticut River.
33	Requires the Licensee to maintain a continuous minimum flow of 1,083 cfs. This flow may be modified temporarily: (1) during and to the extent required by operating emergencies beyond the control of the Licensee; or (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.
34	Requires undertaking consultation and cooperation with the appropriate State Historic Preservation Officer(s) (SHPO) prior to the commencement of any construction or development of any Project works or other facilities at the Project.

License Article	Summary of Requirement
35	Requires installation and operation of signs, light, 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.
36 (December 15, 1980 amendment)	Gives authority to the Licensee to grant permission for certain types of use and occupancy of project lands and waters and to convey certain interests in project lands and waters for certain types of use and occupancy, without prior FERC approval.
37	Requires filing with FERC a feasibility analysis of installing additional generating capacity at the Project.

2.6.4 Compliance History

The Licensee is not aware of any instances of non-compliance with the conditions of the Project license. FERC's New York Regional Office conducts regular inspections as required by FERC regulations. In addition, the Licensee's chief dam safety engineer conducts regular inspections. The Licensee completes all necessary corrective actions to address comments and recommendations arising from inspections by the FERC and/or its chief dam safety engineer in a timely manner.

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3.0 EXISTING ENVIRONMENT AND RESOURCE IMPACTS

3.1 INTRODUCTION

This section presents the existing environment and resource impacts, based on existing, relevant, and reasonably available information, as required by 18 C.F.R. § 5.6(d)(3), including:

- a description of the existing environment;
- summaries of existing data or studies;
- potential adverse impacts and issues related to project construction, operation, or maintenance; and
- existing or proposed resource protection and mitigation measures (facilities, operations, and management activities).

Throughout this section as we discuss the existing environment and resources, we use the following specific terms:

- Middle Connecticut River Basin – a portion of the entire Connecticut River basin that lies above the Holyoke dam upstream to and including the entire area impacted by the Wilder dam impoundment.
- TransCanada Project affected area – a portion of the Middle Connecticut River basin from the Vernon dam upstream to and including the entire area impacted by the Wilder dam impoundment.
- Project affected area – Bellows Falls impoundment to the upstream extent of the Vernon impoundment.
- Terrestrial project area; wetland-riparian project area – resource specific area delineations for the purpose of the PAD that include lands with flowage easements retained by TransCanada and any land owned in fee by TransCanada, plus a 250-foot buffer around the resulting Project boundary.
- RTE project area – the land within a 1,000-foot buffer to the Project boundary.

3.2 GENERAL DESCRIPTION OF THE WATERSHED

The Connecticut River originates in the Fourth Connecticut Lake near the Canadian border; flows in a southerly direction for about 407 miles to the Long Island Sound; and has a drainage area of 11,250 square miles in Vermont, New Hampshire, Massachusetts, and Connecticut. The upper Connecticut River Basin[1] (figure 3.2-1) has a drainage area of 7,751 square miles and is the northern portion of the entire basin. The upper Connecticut River (to Turners Falls dam (Project No. 1889) in Massachusetts) is about 271 miles long.

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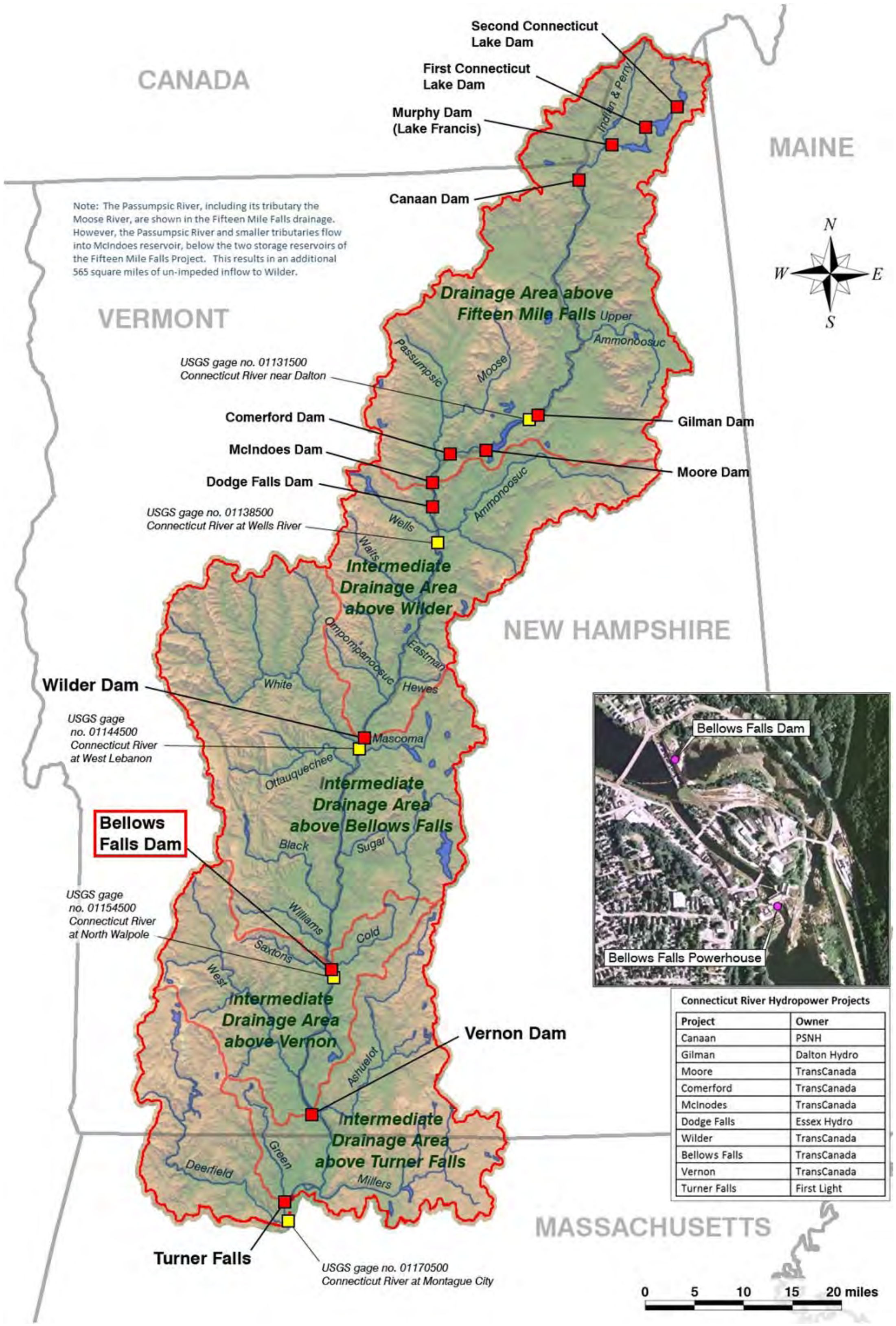
[1] The upper Connecticut River Basin is defined as the northern part of the watershed to the confluence of the Deerfield River, near Greenfield, Massachusetts.



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. Bellows Falls Project and the upper Connecticut River Basin (Source: EPA, 2012, as modified by TransCanada).

There are numerous lakes, ponds, and dams in the Connecticut River Basin. Dams on the main stem of the Connecticut River include First and Second Connecticut Lake dams, Murphy, Canaan, Gilman, Moore, Comerford, McIndoes, Dodge Falls, Wilder, Bellows Falls, Vernon, and Turners Falls. The first dam on the Connecticut River is Holyoke dam, in Holyoke Massachusetts, about 87 river miles upstream of Long Island Sound. Major tributaries to the upper Connecticut River include the Upper Ammonoosuc, Passumpsic, Ammonoosuc, Waits, White, West, Ashuelot, Deerfield, and Millers rivers.

3.3 RIVER BASIN DESCRIPTION

The northern and higher elevation areas of the upper Connecticut River Basin are characterized by rugged terrain in the White and Green Mountains (see figure 3.4-1) with dense northern hardwood and spruce-fir forests. These areas are sparsely populated with only small towns and villages and limited agricultural areas. Most of the larger towns and cities are located at lower elevations and near the Connecticut River Valley. The relatively flat land near the Connecticut River, including the flood plain, has substantial agricultural fields. The Project reservoir extends northward into Windsor County, Vermont, and Sullivan County, New Hampshire.

3.3.1 Major Water Uses

The Connecticut River had been used as a means of log conveyance mostly in the spring for the timber industry from the 1800s until about 1921 when the last major log drive was conducted from the upper basin to the saw mills near Bellow Falls (Connecticut River Watershed Council, www.ctriver.org). Building of the large mainstem hydroelectric specific dams on the Connecticut River near the Project started with the completion of the downstream Vernon dam and powerhouse in 1909. In 1905, a wooden crib dam at Turners Falls Massachusetts was replaced with a concrete dam and started producing electricity in 1907 (Connecticut River Watershed Restoration, www.restoreconnriver.org/history.php). The Bellows Falls Project started operation in 1928. The upstream Fifteen Mile Falls Project consisting of McIndoes, Comerford, and Moore dams was constructed in the 1930s and 1950s, and the upstream Wilder dam was constructed in 1950. The Bellows Falls Project was a redevelopment of a dam, canal and site occupied by an extensive paper mill complex. The surface water of the Connecticut River has long been used for recreational boating, including power boating, canoeing, and rowing as well as sport fishing and hunting.

Water within the Project is used on a limited basis for seasonal irrigation. Treated wastewater from private, commercial, municipal, and industrial sources discharges to both the Connecticut River and its tributaries.

Table 3.3-1 identifies the 12 FERC licensed hydropower and storage projects on the main stem of the Connecticut River. There are also numerous smaller licensed and exempt hydropower projects on the tributaries to the Connecticut River. TransCanada owns and operates dams at First and Second Connecticut Lakes as water storage facilities. The state of New Hampshire owns Murphy dam for storage and coordinates its operation with TransCanada. The USACE operates numerous flood control dams on tributaries in the upper Connecticut River Basin (table 3.3-2).

Table 3.3-1. Mainstem Connecticut River hydropower projects (Source: FERC, 2012).

Project Name	Owner	FERC No.
Canaan	PSNH	P-7528
Gilman	Dalton Hydro	P-2392
Moore	TransCanada	P-2077
Comerford	TransCanada	P-2077
McIndoes	TransCanada	P-2077
Dodge Falls[a]	Essex Hydro	P-8011
Wilder	TransCanada	P-1892
Bellows Falls	TransCanada	P-1855
Vernon	TransCanada	P-1904
Turners Falls	First Light	P-1899
Northfield Mountain (pump storage)	First Light	P-2485
Holyoke	Holyoke Gas and Electric	P-2004

[a] Exempt project.

Table 3.3-2. USACE's flood control dams (Source: Brown, 2009).

Project Name	Watershed	State
Union Village	Ompompanoosuc	VT
Deweys Mills	Ottauquechee	VT
North Hartland	Ottauquechee	VT
Stoughton Pond	Black	VT
North Springfield	Black	VT
Ball Mountain	West	VT
Townshend	West	VT
Surry Mountain	Ashuelot	NH
Otter Brook	Ashuelot	NH

3.3.2 Drainage Basin's Tributary Streams

Table 3.3-3 describes the major tributaries flowing into the Connecticut River in the Project area.

Table 3.3-3. Project area major tributary information (Source: USGS, 2012; USACE, 1975; CRJC, 2009a; CRJC, 2009b; CRJC, 2009c; FWS, 2010; New Hampshire DES, 2012).

Tributary	Town, State	Drainage Area (square miles)	Enters CT River at RM
Upstream of Bellows Falls Dam			
White River	White River Junction, VT	712	215.1
Mascoma River	West Lebanon, NH	194	214.2
Ottauquechee River	North Hartland, VT	222	210.2
Sugar River	West Claremont, NH	275	195.2
Black River	Springfield / Gould Mill, VT	204	183.1
Williams River	Rockingham, VT	118	176.4
Downstream of Bellows Falls Dam but upstream of Vernon Project			
Saxtons River	North Westminster, VT	78	172.5
Cold River	Cold River, NH	102	171.9

Note: Upstream of Bellows Falls dam in this context does not include tributaries that are upstream of Wilder dam.

White River

The White River originates in the Green Mountains on the slopes of Bread Loaf Mountain in eastern Addison County, Vermont and flows east and south through the towns of Granville, Hancock, Rochester, Stockbridge, Bethel, Royalton, Sharon, Hartford, and enters the Connecticut River at White River Junction. The river does not have any dams on its main stem. It is the largest tributary to the Connecticut River (710 square mile drainage area) and is about 60 miles long (CRJC, 2009a; FWS, 2010).

Mascoma River

The Mascoma River originates in the town of Dorchester, New Hampshire, in Grafton County and flows south and west through the towns of Canaan and Enfield and flows into the Connecticut River in Lebanon. Its upper section has numerous water storage reservoirs operated by the state of New Hampshire, while its lower section has numerous small run-of-river hydropower projects. The first dam, which is about 1.5 RM above the confluence with the Connecticut River, is the Glen Road Hydro dam (FERC No. 8405) in West Lebanon, New Hampshire. The river is about 32 miles long and has a drainage area of about 194 square miles (New Hampshire DES, 2012; FWS, 2010).

Ottauquechee River

The Ottauquechee River originates in the Green Mountains near Killington, Vermont, in eastern Rutland County and flows east through the towns or villages of Bridgewater, Woodstock, Pomfret, Hartford, Woodstock, and Quechee, before joining the Connecticut River in Hartland. North Hartland Lake, a USACE flood control dam, is located about 1.5 RM upstream of the confluence with the Connecticut River. There are a couple small hydropower projects on the lower portion of the river including one connected to the USACE dam outlet works. The first dam, which is about 0.3 RM above the confluence with the Connecticut River, is the White Current dam (FERC No. 2787) in Hartland, Vermont. The river is about 41 miles long and has a drainage area of about 222 square miles (CRJC, 2009b; FWS, 2010).

Sugar River

The Sugar River originates at the outlet of Lake Sunapee, also controlled by the state of New Hampshire, in eastern Sullivan County, New Hampshire, and flows westward through the towns of Sunapee and Newport before joining the Connecticut River at Claremont. Numerous small hydropower projects exist along the river, and the first dam about 1.6 RM above the confluence with the Connecticut River is the Sweetwater dam (FERC No. 10898) in Claremont, New Hampshire. The river is about 27 miles long and has a drainage area of about 275 square miles (New Hampshire DES, 2012; FWS, 2010).

Black River

The Black River originates in Plymouth, Vermont, in western Windsor County and flows generally eastward through the towns of Ludlow, Cavendish, Weathersfield, and enters the Connecticut River in Springfield. The North Springfield dam, a USACE flood control dam, is located about 7 miles upstream from the Connecticut River. There are dams and hydropower projects along portions of the river, and the first dam about 4 RM above the confluence with the Connecticut River is the Lovejoy dam (FERC No. 9649) in Springfield, New Hampshire. The river is about 41 miles long and has a drainage area of about 204 square miles (CRJC, 2009b; FWS, 2010).

Williams River

The Williams River originates in the town of Andover in western Windsor County, Vermont, and flows generally southeasterly through the towns of Ludlow and Chester and enters the Connecticut River in Rockingham. The first dam, which is about 5 RM above the confluence with the Connecticut River, is the Brockway Mills dam (FERC No. 3131) in Rockingham, Vermont. The river is about 27 miles long and has a drainage area of about 118 square miles (CRJC, 2009b; FWS, 2010).

Saxtons River

The Saxtons River originates near Grafton, Vermont, in western Windham County and flows through the town of Saxtons River and enters the Connecticut River in Westminster. The river does not have dams on its main stem, it is about 20 miles long and has a drainage area of about 78 square miles (CRJC, 2009c; FWS, 2010).

Cold River

The Cold River originates near the towns of Acworth and Unity in Sullivan County, New Hampshire, and flows south and west to the Connecticut River at the town of

Walpole. The first dam, which is about 7 RM above the confluence with the Connecticut River, is Vilas Pool dam in Alstead, New Hampshire. The river is about 24 miles long and has a drainage area of about 100 square miles (New Hampshire DES, 2012; FWS, 2010).

Flow and stage data for the Project area are available from seven USGS gages upstream of the Project dam and four downstream (table 3.3-4), that have recorded water elevation and discharge in the Connecticut River and select tributaries generally at 15 minute intervals. Additionally, TransCanada records reservoir level, generation, and discharge continuously at the Project.

Table 3.3-4. Active or recently deactivated USGS gages in the project area (Source: USGS, 2012).

Site Number	Site Name	Data	Drainage area (square miles)
Upstream of Bellow Falls dam			
01144000	White River at West Hartford, VT	1915-06-09 to present	690
01144500	Connecticut River at West Lebanon, NH	1911-11-01 to present	4092
01150500	Mascoma River at Mascoma, NH	1923-08-16 to 2004-09-30	153
01151500	Ottauquechee River At North Hartland, VT	1930-10-01 to present	221
01152500	Sugar River at West Claremont, NH	1928-05-25 to present	269
01153000	Black River at North Springfield, VT	1929-11-26 to 1989-09-30 and 2012-04-30 to present	158
01153550	Williams River near Rockingham, VT	1986-10-01 to present	112
Upstream of Vernon Dam			
01154000	Saxton River at Saxton River, VT	1940-06-20 to present	72.2
01154500	Connecticut River and North Walpole, NH	1942-03-06 to present	5493
01154950	Cold River at High Street, at Alstead, NH	2009-09-16 to present	74.6

3.3.3 Climate

In the vicinity of the Project summers are mild and humid and winters are cold. Average July temperatures range from a daily average maximum of 82 degrees

Fahrenheit (°F) and a daily average minimum of 59° F. Average January temperatures range from a daily average maximum of 31° F and a daily average minimum of 10° F. The average annual precipitation is 40.3 inches and is relatively evenly distributed throughout the year (U.S. Climate Data, 2012). The average annual snowfall is about 60 inches (Vermont State Climate Office, 2012).

3.3.4 References

Brown, R. 2009. *Where the Great River Rises, an Atlas of the Connecticut River Watershed in Vermont and New Hampshire*, Rebecca A. Brown (Editor). A project of the Connecticut River Joint Commissions.

CRJC (Connecticut River Joint Commissions). 2009a. Water Resources, Connecticut River Management Plan, Upper Valley Region. CRJC. Charlestown, NH. http://crjc.org/new%20WR3%20chapter/WATER_RESOURCES_UpperValley.pdf. (accessed August 28, 2012).

CRJC. 2009b. Water Resources, Connecticut River Management Plan, Mount Ascutney Region. CRJC. Charlestown, NH. http://crjc.org/new%20WR3%20chapter/WATER_RESOURCES_Mount Ascutney.pdf. (accessed August 28, 2012).

CRJC. 2009c. Water Resources, Connecticut River Management Plan, Wantastiquet Region. CRJC. Charlestown, NH. http://crjc.org/new%20WR3%20chapter/WATER_RESOURCES_Wantastiquet.pdf. (accessed August 28, 2012).

EPA (U.S. Environmental Protection Agency). 2012. National Rivers and Streams Assessment. Home. EPA, May 2011. Web. 30 Aug 2012. http://water.epa.gov/type/rsl/monitoring/riverssurvey/index.cfm (accessed September 10, 2012).

FERC (Federal Energy Regulatory Commission). 2012. List of issued Licenses. Available at: http://www.ferc.gov/industries/hydropower/gen-info/licensing/licenses.xls. (accessed on August 29, 2012). Washington, DC.

FWS (U.S. Fish and Wildlife Service). 2010. Appendix B, Description of the Connecticut River Basin. Connecticut River Coordinator's Office, Northeast Fisheries Resources Home. Available at: http://www.fws.gov/r5crc/Stuff/appb.html (accessed on August 25, 2012, last updated on September 13, 2010). FWS, Northeast Region Home, Sunderland, MA.

New Hampshire DES (New Hampshire Department of Environmental Services). 2012. River and Lakes Fact Sheets. Available at: http://des.nh.gov/organization/commissioner/pip/factsheets/rl/index.htm. (accessed on August 30, 2012). Concord, NH.

USACE (U.S. Army Corps of Engineers). 1975. Water Resources Investigation: Connecticut River Streambank Erosion Study, Plan of Survey. New England Division. Waltham, MA.

U.S. Climate Data. 2012. Climate data for Bellow Falls, VT. Available at: http://www.usclimatedata.com/climate.php?location=USVT0014. (accessed on September 5, 2012).

USGS (U.S. Geological Survey). 2012. National Water Information System web page, Water Data for the Nation. Available at: http://nwis.waterdata.usgs.gov/nwis. (accessed on July 27, 2012).

Vermont State Climate Office. 2012. Climate of Vermont. Available at: http://www.uvm.edu/~vtstclim/?Page=climate_vermont.html&SM=vtclimsub.html (accessed on September 5, 2012). University of Vermont, Burlington, VT.

3.4 GEOLOGY AND SOILS

3.4.1 Summary of Existing Studies

For descriptions of the geological and soil resources at, or in the vicinity of, the Project, we reviewed:

- Draft Lower Connecticut River Shoreline Survey Report – 2010. Bellows Falls, Wilder, and Vernon Projects (Kleinschmidt, 2011).
- Technical Report – Phase 1A Archaeological Reconnaissance Survey, Bellows Falls Hydroelectric Project (FERC No. 1855). Windham and Windsor Counties, Vermont, and Cheshire and Sullivan Counties, New Hampshire (PAL, 2012).
- Soil Survey of Sullivan County, New Hampshire (USDA, 1983).
- Soil Survey of Cheshire County, New Hampshire (USDA, 1989).
- Soil Survey of Windham County, Vermont (USDA, 1987).
- Natural Resource Conservation Service – Web Soil Survey (NRCS, 2012).
- Fluvial Geomorphology Assessment of the Northern Connecticut River, Vermont and New Hampshire) (Field, 2004).
- Riparian Buffers for the Connecticut River Valley (CRJC, 2001a).
- Connecticut River Corridor Management Plan (CRJC, 1997).
- Water Resources – Connecticut River Management Plan – Mount Ascutney Region (CRJC, 2009a).
- Water Resources – Connecticut River Management Plan – Wantastiquet Region (CRJC, 2009b).
- USACE Connecticut River Streambank Erosion Study – Massachusetts, New Hampshire and Vermont (Simons et al, 1979).

- *Where the Great River Rises, An Atlas of the Connecticut River Watershed in Vermont and New Hampshire (Brown, 2009).*

3.4.2 Topography

The Project is located within the New England Uplands section of the New England Physiographic Province (figure 3.4-1). Within the smaller biophysical regions of southeastern Vermont and southwestern New Hampshire, the Project area lies in the southern Vermont Piedmont (PAL, 2012). This is an area to the east of the Green Mountains that runs the entire length of the two states from Canada to Massachusetts, and it includes the Connecticut River valley. It is the largest physiographic region common to the two states. The floodplains and terraces adjacent to the river generally range from elevation 90 to 200 feet mean sea level (msl).[2] The upland hills adjacent to river terraces generally range from elevation 200 to 500 feet msl.

The word piedmont, which means "at the foot of the mountains," is used to describe an area of foothills, and this area is made up of rolling hills and valleys at the foot of the Green Mountains that extend into western New Hampshire. The most notable feature of the piedmont landscape is a number of mountains that rise above the surrounding landscape. These isolated mountains are called monadnocks a word believed to originate in Abenaki that means "island mountain place," and consist of resilient granite outcrops. Mount Ascutney in Vermont is the most notable monadnock in the region of the Project.

3.4.3 Geological Features

Geologically, the Project lies within the Connecticut River valley-Gaspé Basin. This geological area takes up the eastern third to half of the state of Vermont and forms the western border of New Hampshire. Bedrock comprises a sedimentary basin characterized by thick deposits of calcareous sediments including shales and limestones. This basin contains sedimentary, metamorphic, and igneous rock types of Silurian and Devonian age belonging to the Littleton, Partridge, and Clough formations. Igneous bedrock includes felsic intrusions from which Vermont's famous granite is quarried. Specific bedrock rock types along the Project area include quartz diorite, quartzite, quartz conglomerate, granodiorite, slate, limestone, amphibolites, phyllite, aluminous schist, calc-silicate granofels, and metavolcanics.

Surficial geological deposits along the Project area consist of glaciofluvial, glaciolacustrine, postglacial fluvial sands and gravels, and recent alluvium along the banks of the Connecticut River, and glacial till in the adjacent upland areas. The surficial geology of the Project area is in large part attributable to glacial processes. The final Pleistocene advance and retreat of the continental ice mass during the Wisconsin Period eroded and picked up bedrock, realigned drainages, and deposited till, erratics, and glacial moraine along its course. The retreat of the ice from

[2] Unless otherwise noted, all elevations in the document are in feet above mean sea level.

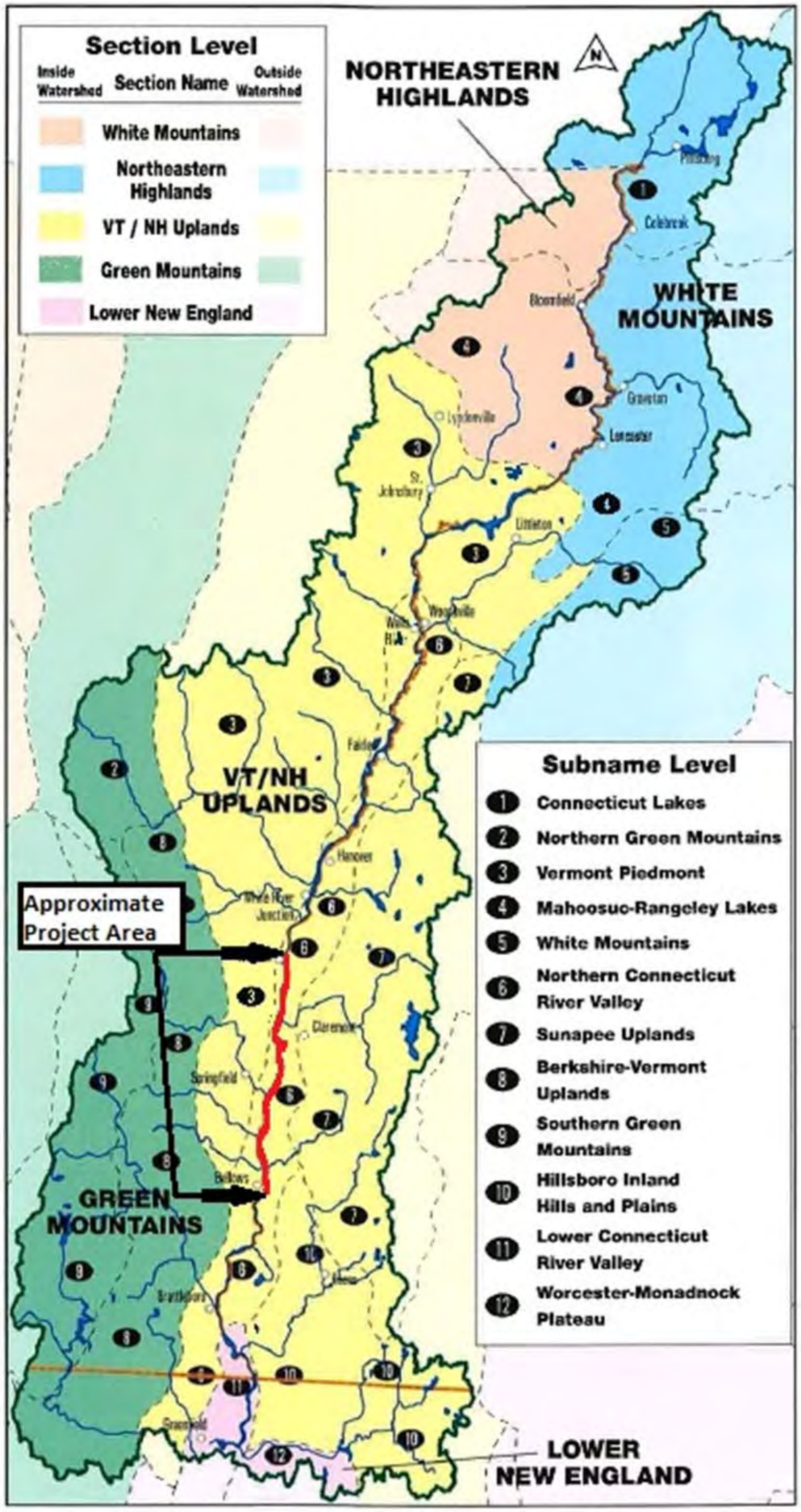


Figure 3.4-1. Physiographic regions of Vermont and New Hampshire showing the Project area (Source: Brown, 2009).

Vermont and New Hampshire about 13,500 years ago left widespread glacial deposits and glacial erosional surfaces. An important part of the deglaciation in this area was the formation of temporary lakes along the margins of the ice fronts. The Connecticut River Valley along the Project area is situated within the boundaries of glacial Lake Hitchcock. Glacial Lake Hitchcock formed as glacial meltwaters released from the ice sheet were dammed behind a natural sand, gravel, and till barrier deposited in the area of Rocky Hill, Connecticut, to the south. Continued ice melt resulted in a massive natural lake impoundment north of the Rocky Hill dam, which at its maximum stretched some 200 miles from Rocky Hill to St. Johnsbury, Vermont, and reached a width of some 20 miles. The Connecticut River appears to have essentially continued along the same preglacial course following the drainage of glacial Lake Hitchcock. Glacial Lake Hitchcock persisted in the upper Connecticut Valley until about 12,300 years ago, and its existence likely overlapped with the earliest presence of humans in the area.

3.4.4 Soils

Numerous soil types are present along the Project area. Soil types situated on terrace formations along the Connecticut River include loamy sands and sandy loams associated with the Quonset, Windsor, Agawam, Ninigret series, and Warwick series gravelly loam. These soils formed from deposits laid down as glacial outwash. Silt loams associated with the Hitchcock, Belgrade, and Unadilla Variant soil series are also present and formed in glaciolacustrine deposits likely associated with glacial Lake Hitchcock. Other terrace soil types consist of units classified as Urban land-Windsor-Agawam complex and pits, sand and pits, gravel. The Urban land-Windsor-Agawam complex represents areas where anthropogenically disturbed soils are intermixed with small areas of undisturbed sandy loam Windsor and Agawam series soils. Pits, sand and pits, gravel soil types represent areas of gravel and sand quarrying or borrow pits.

Soil types along floodplains include moderately erodible sandy loams associated with the Podunk, Rumney, Hadley, and Ondawa soil series and highly erodible silt loams associated with the Winooski and Limerick soil series. Adjacent upland areas contain sandy loams associated with the Tunbridge, Marlow, Lyman, and Monadnock soil series and silt loams associated with the Dummerston, Macomber, Bernardson, Cardigan, Kearsarge, and Dutchess soil series. Taconic channery loam soils are also present in upland areas. These upland soils can be rocky to very rocky. Other soil types present in upland areas include the Glover-Vershire complex, Lyman-Rock outcrop complex, Macomber-Taconic complex and Vershire-Dummerston complex. These soils can often consist of a shallow mantle overlying bedrock, and are frequently interspersed with bedrock outcrops. Udorthent and Udipsamment soil types are also present and consist of human-transported fill deposits. Soil maps for the Project area can be generated at websoilsurvey.nrcs.usda.gov.

3.4.5 Reservoir Shoreline and Streambanks

The Bellows Falls impoundment was created in 1927 with the completion of the hydroelectric dam between the Village of Bellows Falls (Rockingham), Vermont, and Walpole, New Hampshire. Flooding of the river shorelines upstream to the Project terminus at Horseback Ridge in Windsor, Vermont, widened the river channel in low-lying areas to about elevation 292 feet (msl), as can be discerned from pre-dam construction town and USGS maps. The Bellows Falls impoundment is normally operated between elevations 289.6 feet (msl) and 291.4 feet (msl), although the current license allows the Project to fluctuate between elevations 288.6 feet (msl) and 291.6 feet (msl).

The Connecticut River in Massachusetts, New Hampshire, and Vermont was the subject of a detailed streambank erosion study conducted in 1979 for the USACE (Simons et al., 1979). The Bellows Falls impoundment was evaluated in this study. The study discussed the various processes that occur along the Connecticut River and 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; and (2) those forces acting on the full height of the submerged bank such as what occurs during periodic high flow events.

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.

The next phase of the erosion process is the bank erosion caused by high velocity flows, or an exertion of tractive shear stress on the bank of the flowing water. Under these circumstances, the maximum force acting on the bank is submerged a considerable distance below the water surface, erosion of the entire bank occurs, and the major bank line moves landward. As the bank line moves landward, the berm formed by water surface fluctuation and related phenomena is overtaken, and in many instances, the bank line may move so far landward that effects caused by past near-surface erosion phenomena are eroded. After the termination of the flood, the surface forces cause the formation of a new bench or berm, and the cycle continues.

In anticipation of the relicensing of the project, TransCanada initiated a new study of erosion sites currently present on the Bellows Falls impoundment. The primary type of erosion present along the shoreline of the Project impoundment is bank slumping (Kleinschmidt, 2011), which is the result of 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. This type of erosion is exacerbated by land/vegetation clearing close to the bank, commonly associated with farming practices observed along the Project boundaries. Bank slumping results in bare near-vertical bank walls with large clumps of vegetated bank slumped below the obvious original location of the vegetation. Kleinschmidt's 2010 survey (Kleinschmidt, 2011) reported 51 locations of bank erosion in the Bellows Falls impoundment, with 28 (or 54 percent) associated with agricultural land use practices. Other causes of erosion can include:

rapid recession of high water levels following spring melt and storm events, freeze-thaw and wet-dry cycles, ice and debris movement, surface run-off of rainwater, removal or loss of vegetation, obstacles in the river (e.g., docks, marinas, retaining walls, riprap, boat launches, bridge abutments), and waves and boat wakes.

The Project is operated in a daily cycle run-of-river mode, which results in a modest impoundment level fluctuation between elevation 289.9 and 291.1 feet (msl) under normal operating conditions. The 2010 shoreline survey and the 1979 streambank erosion study report concluded that Project operations would not likely be a significant contributor to erosion in the impoundment as compared to naturally occurring high river flows coupled with highly susceptible soils (Kleinschmidt, 2011; Simons et al., 1979). Agricultural use along the shoreline and Project boundary was identified as a contributing factor to erosion coupled with moderate levels of recreational access and use and development, though limited, along much of the Project shoreline (Kleinschmidt, 2011).

A Phase 1A archaeological survey observed moderate to severe erosion along sections of the impoundment shoreline upstream of Bellows Falls dam, the nature of which, along with identified archaeological resources and sensitive areas, are described in detail in PAL (2012). The Phase 1A archaeological survey took place within only a couple of months after tropical storm Irene in August of 2011. The storm likely contributed to an increase in the severity of erosion in the areas that had already been noted during the 2010 shoreline survey (Kleinschmidt, 2011). The majority of the previously recorded archaeological sites are situated at the edge of the river on first terraces where agricultural practices have strongly contributed to ongoing erosion, the loss of stabilizing vegetation, and ultimately bank slumpage and failures. All nine pre-contact sites identified during the course of the Phase 1A archaeological survey were found in eroding banks below cultivated fields.

The maintenance of adequate vegetated riparian buffer zones has proved to be a key factor in reducing the occurrence and severity of bank erosion and the protection of cultural resource sites located along the shoreline of the river. In 2002, the state of New Hampshire enacted the Shoreland Protection Act (R.S.A. 483-B). The Act empowers the Commissioner of the New Hampshire DES to enforce the Act. The Act establishes requirements to maintain a minimum vegetated Waterfront Buffer of 50 feet along the Connecticut and other rivers, and a secondary Natural Woodland Buffer zone within 150 feet of the shoreline in which 25 percent of the natural vegetation is to be left unaltered. Where this buffer zone has been maintained, there has been no significant erosion or exposure of archaeological sites (PAL, 2012). In other places, attempts by private landowners to comply with the provisions of the Shoreland Protection Act are evident, but these have not been in place long enough to curtail bank erosion. Vermont does not require a riparian buffer zone, which allows farmers to plant crops to the top of the bank.

3.4.6 Project Effects

TransCanada 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.

3.4.7 References

Brown, R. 2009. *Where the Great River Rises, an Atlas of the Connecticut River Watershed in Vermont and New Hampshire*, Rebecca A. Brown (Editor). A project of the Connecticut River Joint Commissions.

CRJC (Connecticut River Joint Commissions). 2009a. Water Resources, Connecticut River Management Plan, Upper Valley Region. CRJC. Charlestown, NH. (http://crjc.org/new%20WR3%20chapter/WATER_RESOURCES_UpperValley.pdf)

CRJC. 2009b. Water Resources, Connecticut River Management Plan, Mount Ascutney Region. CRJC. Charlestown, NH. (http://crjc.org/new%20WR3%20chapter/WATER_RESOURCES_MountAscutney.pdf)

CRJC. 2001a. Riparian buffers for the Connecticut River Valley, Connecticut River Joint Commissions, Lebanon, NH. 2001.

CRJC. 1997. Connecticut River Corridor Management Plan, Connecticut River Joint Commissions, Charlestown, New Hampshire. May 1997

Field Geology Services. 2004. Fluvial Geomorphology of the Northern Connecticut River, Vermont and New Hampshire. Farmington, ME. October 2004.

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.

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.

NRCS (Natural Resources Conservation Service). 2012. Web soil survey. http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm accessed August 30, 2012.

PAL (Public Archaeology Laboratory). 2012. Technical Report – Phase 1A Archaeological Reconnaissance Survey, Bellows Falls Hydroelectric Project (FERC No. 1855). Windham and Windsor Counties, Vermont, and Cheshire and Sullivan Counties, New Hampshire. Pawtucket, Rhode Island. February 2012.

PAL. 2008. Technical Report – Phase 1A Archaeological Reconnaissance Survey, Vernon Hydroelectric Project (FERC No. 1904). Windham County, Vermont, and Cheshire County, New Hampshire. Pawtucket, Rhode Island. March 2008.

Simons, D.B., Andrews, J.W., Li, R.M., and Alawady, M.A. 1979. Connecticut River Streambank Erosion Study Massachusetts, New Hampshire, and Vermont. November 11, 1979. Prepared for the United States Army Corps of Engineers, New England Division.

USDA. 1989. Soil Survey of Cheshire County, New Hampshire. United States Department of Agriculture, Washington, D.C. (not seen, as cited in Hubbard et al., 2012)

USDA. 1987. Soil Survey of Windham County, Vermont. United States Department of Agriculture, Washington, D.C. (not seen, as cited in Hubbard et al., 2012)

USDA. 1983. Soil Survey of Sullivan County, New Hampshire. United States Department of Agriculture, Soil Conservation Service, Washington, D.C. (not seen, as cited in Hubbard et al., 2012)

3.5 WATER RESOURCES

3.5.1 Summary of Existing Studies

The following sources were used to describe the water resources at, or in the vicinity of, the Bellow Falls Project.

- U.S. Geological Survey, National Water Information System web page, Water Data for the nation. Available at: http://nwis.waterdata.usgs.gov/nwis.
- Hourly flow and reservoir levels for January 1, 2001, to December 31, 2011 for the Bellow Falls Project from TransCanada.
- Operational procedures for the Bellow Falls Project from TransCanada.
- *Where the Great River Rises, An Atlas of the Connecticut River Watershed in Vermont and New Hampshire*, Rebecca A. Brown, (Editor.) A project of the Connecticut River Joint Commissions. 2009.
- EPA Watershed Basin Information. Available at: http://water.epa.gov/scitech/datait/models/basins/BASINS4_index.cfm.
- Freshwater Mussel Survey in the Connecticut River for Vernon, Bellows Falls, and Wilder Hydroelectric Projects. Prepared for TransCanada Hydro Northeast Inc. by Biodrawversity LLC and the Louis Berger Group, 2012.

- Aerial photos, topographic maps, USGS maps, and Google Earth.
- New Hampshire DES Surface Water Quality Assessments 305(b)/303(d) Integrated reports 2006, 2008, 2010 and 2012;
- Vermont DEC Surface Water Quality Assessments 305(b) and 303(d) reports 2012;
- New Hampshire DES 2004 Connecticut River Water Quality Assessment Project;
- Connecticut River Joint Commissions (CRJC) Corridor Management Plan and Water Resources Management Plans;
- U.S. Geological Survey (USGS) National Water Quality Assessment (NAWQA) Program;
- Connecticut River Water Quality Monitoring Project, conducted by the Pioneer Valley Planning Commission and Connecticut River Watershed Council in partnership with the University of Massachusetts Water Resources Research Center;
- Tri-State Connecticut River Targeted Watershed Initiative; and
- TransCanada and Normandeau Associates Inc. (Normandeau) water quality sampling data and reports.

3.5.2 Hydrology

The Connecticut River basin covers about 11,250 square miles in Vermont, New Hampshire, Massachusetts, and Connecticut. The upper Connecticut River watershed (see figure 3.1-1), covers about 7,751 square miles of eastern Vermont, western New Hampshire, and extreme north central Massachusetts. Generally, the Lake Champlain and Hudson River watersheds are located to the west and the Androscoggin, Saco, and Merrimack River watersheds are located to the east. The upper Connecticut River watershed has a length in the north-south direction of about 315 miles and a width that varies between 30 and about 50 miles (EPA, 2012).

The main stem of the Connecticut River from its source in northern New Hampshire to Turners Falls dam in northern Massachusetts is about 271 miles long. The Bellows Falls dam, located at RM 173.7, and its impoundment extends about 26 miles upstream to a point about 17 miles below TransCanada's Wilder dam. The depth of the reservoir at low flow conditions ranges from several feet at the upper end, to about 30 feet near the dam. Water released from the Project flows into the Vernon impoundment about 6 miles downstream of the Bellows Falls dam. A short (about 0.7-mile-long) bypassed reach stretches between the dam and the powerhouse tailrace.

Drainage Area

The Bellows Falls reservoir extends northward into Windsor County, Vermont, and Sullivan County, New Hampshire. The reservoir has a total drainage area of 5,414 square miles and a surface area of about 2,804 acres and is about 26 miles long with a shoreline of over 74 miles. Of the total Connecticut River drainage area upstream of the Bellows Falls dam, 2,039 square miles or more than 37 percent of the total enters as unmanaged inflow below Wilder dam except under flood flow conditions when USACE dams store water temporarily. See section 3.1, *General Description of the Watershed*, for further information about the river basin.

Reservoir Characteristics

Bellows Falls reservoir has a total water storage volume of 26,900 acre-feet. The licensed operating range of the Project is from a minimum elevation of 288.6 feet msl to a maximum of 291.6 feet msl; however, the normal operating range is between elevation 289.6 and 291.4 feet msl. There is about 7,476 acre-feet of usable storage in the 3 feet of licensed operating range, representing less than one seventh of the volume of the average daily inflow during April, the month of the highest average flows. The Bellows Falls reservoir is riverine in character and ranges in depths of several feet to about 30 feet near the dam. Bathymetry within the reservoir changes rapidly as the result of deposition and scour during high flows such as those that occurred with Tropical Storm Irene in late August 2011. The mean depth of the reservoir is about 10 feet, and it has a flushing rate of less than 2 days based on the average daily flow of about 10,500 cfs. The maximum discharge capacity of the Project is 119,785 cfs, and the flood of record of 156,000 cfs occurred in March 1936. Since then, five upstream USACE flood control structures have been built, as well as Moore dam that has some flood control capability, and these have helped to decrease the peak flow during flood events. Moore dam started operation in the late 1950s; the highest flow recorded at the Project as measured at the dam by TransCanada was 103,397 cfs during the Irene flood event on August 29, 2011.

The substrate of the reservoir features two physically distinct reaches, downstream of the Weathersfield Bow (about RM 193) the substrate consists of silt, sand, and fine gravel. Upstream of the Weathersfield Bow the river is narrower and shallower and there is a higher proportion of gravel, cobble, and boulder substrate (Biodrawversity and LBG, 2012).

Reservoir levels are set in relation to anticipated inflows. If anticipated inflows are likely to exceed the station capacity of 11,400 cfs, TransCanada normally pre-draws the reservoir level gradually by opening a roller gate. When inflows are above the station capacity but not expected to exceed 20,000 cfs, TransCanada uses one of the roller gates to keep the reservoir level at 291.1 feet msl or less and limit the drawdown of the reservoir to less than 0.3 foot per hour under these and all conditions. At flows over 20,000 cfs, both roller gates are used to control the reservoir level to 290.1 feet msl, including the removal of upper panelized sections of stanchion boards to keep the reservoir at levels less than elevation 291.0 feet msl. At flows exceeding 50,000 cfs, both roller gates are used to limit the reservoir elevation to 289.6 feet msl and if flows continue to increase then stanchions are used to regulate the level to not more than elevation 291.4 feet except under extreme flood conditions.

For instance, during the Tropical Storm Irene flood (August 29, 2011), the reservoir level peaked at elevation 291.60 feet msl with a peak discharge of 103,397 cfs. Figure 3.5-1 provides a bar and whisker graph showing the average hourly median, average, minimum, maximum, and the 5, 25, 75, and 95 percent exceedence values for reservoir levels from January 1, 2001, to December 31, 2011. The minimum reservoir level in this time period reached about elevation 283.5 feet in early September 2011 due to the necessity to pull two bays of stanchions and a portion of a third (between the concrete piers).

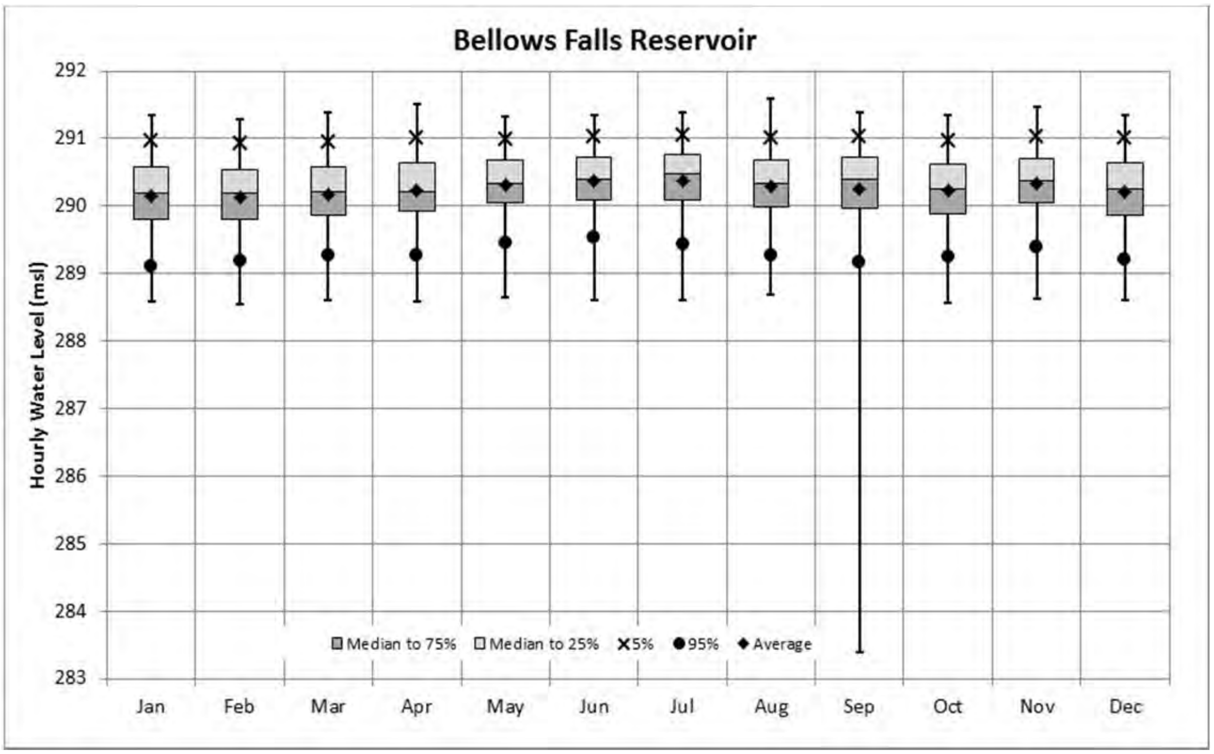


Figure 3.5-1. Bellows Falls reservoir levels for January 1, 2001, to December 31, 2011.

In addition, the normal lowering of the reservoir level during high flow conditions at the dam helps decrease the water level in the upper reaches of the impoundment as well as in the upstream riverine reach where backwater effects from the impoundment under heavy inflow can materialize. TransCanada limits the reservoir drawdown rate to no more than 0.3 foot per hour. The relatively small storage volume of the reservoir does not have a substantial effect on flood flows, but a lower reservoir level during flood events does help limit flooding on the upper reaches of the reservoir and farther upstream on the riverine reach.

Under normal generation conditions, it takes about 4 hours for flows released from the upstream Wilder Project to reach Bellows Falls dam and 4 hours for releases from Bellows Falls to reach the Vernon Project. Figures 3.5-2 through 3.5-5 provide monthly exceedence curves for USGS gage No. 01154500 - Connecticut River at

North Walpole, New Hampshire, located downstream of the confluence with Saxtons River (about 2 miles from Bellows Falls dam). To estimate flow from only the Bellows Falls Project, the daily flow from the North Walpole gage was prorated by 0.986 to remove the small effect of inflow from Saxtons River under most circumstances. Table 3.5-1 provides a summary of the minimum, average, and maximum monthly values for the same data set as the exceedence curves.

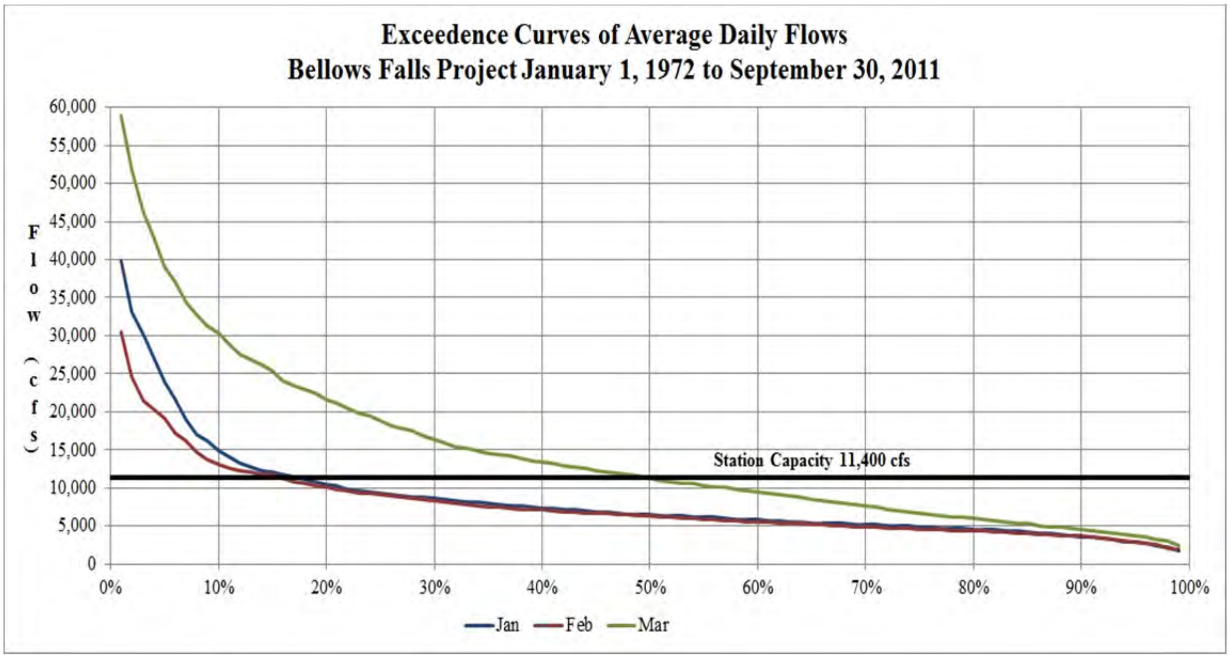


Figure 3.5-2. Exceedence curves for January, February, and March (Source: USGS, 2012, as modified by TransCanada).

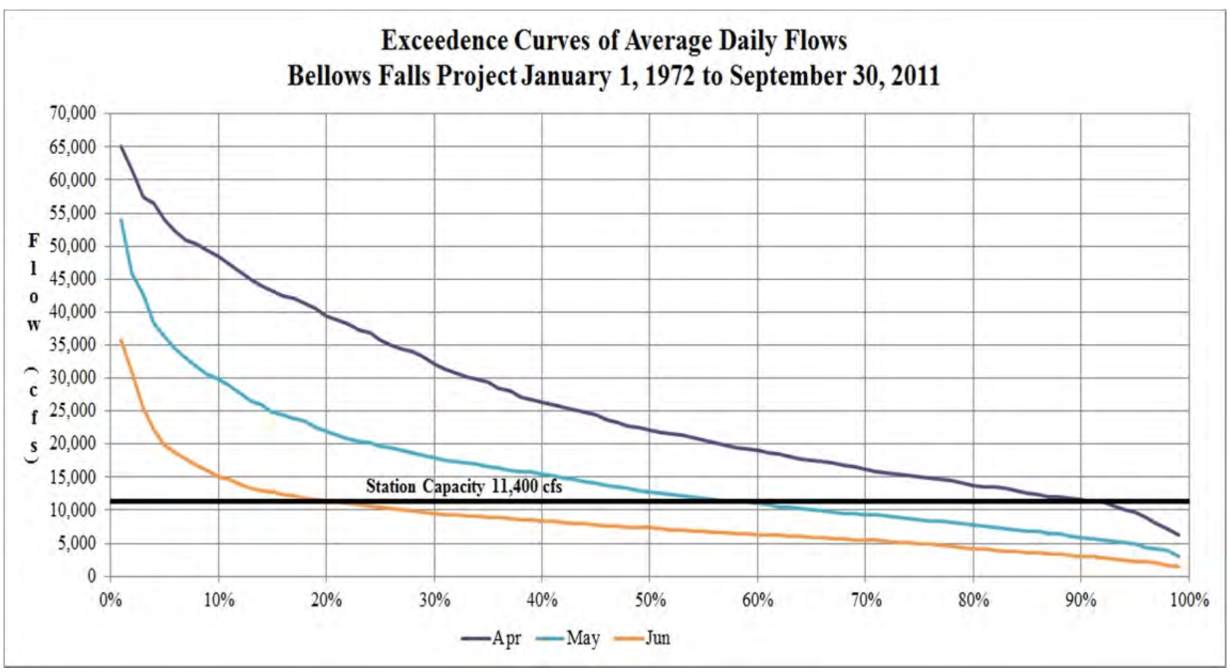


Figure 3.5-3. Exceedence curves for April, May, and June (Source: USGS, 2012, as modified by TransCanada).

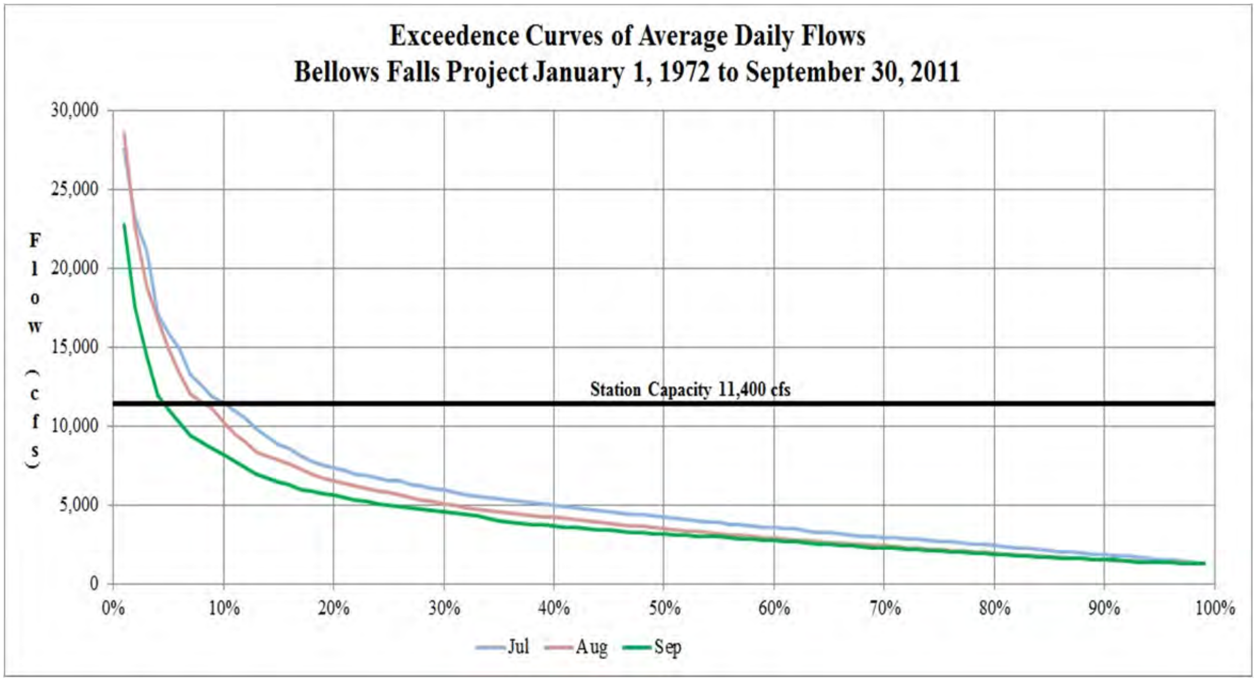


Figure 3.5-4. Exceedence curves for July, August, and September (Source: USGS, 2012, as modified by TransCanada).

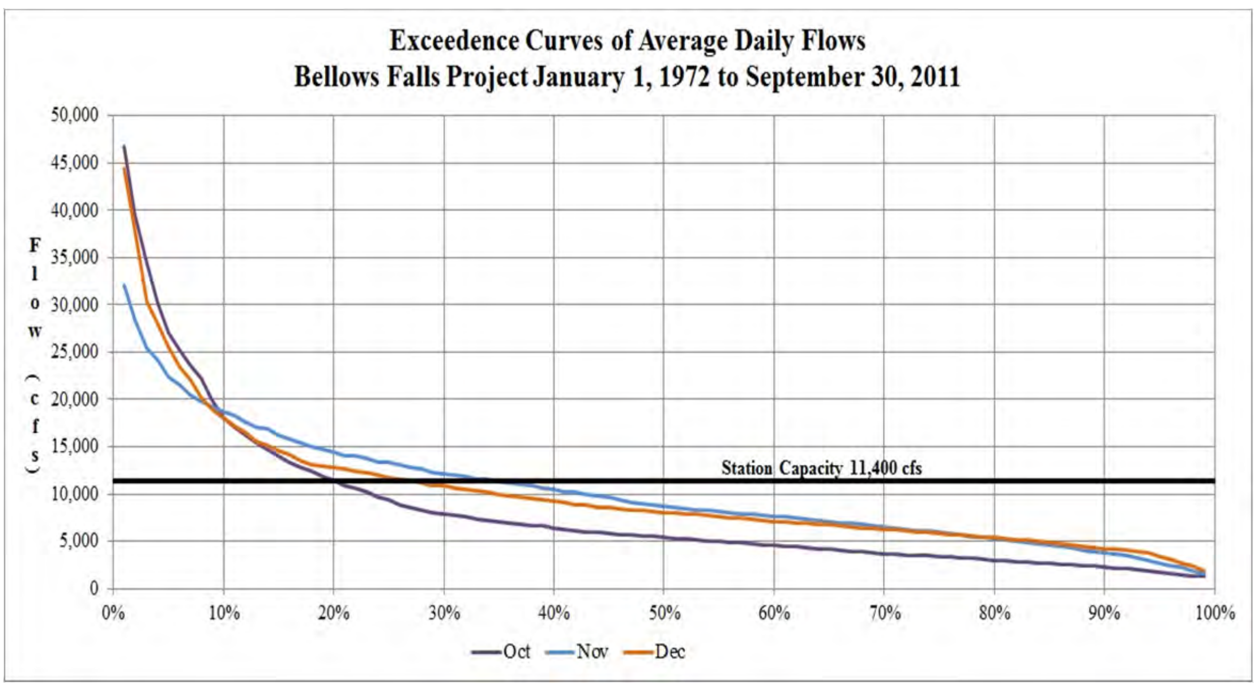
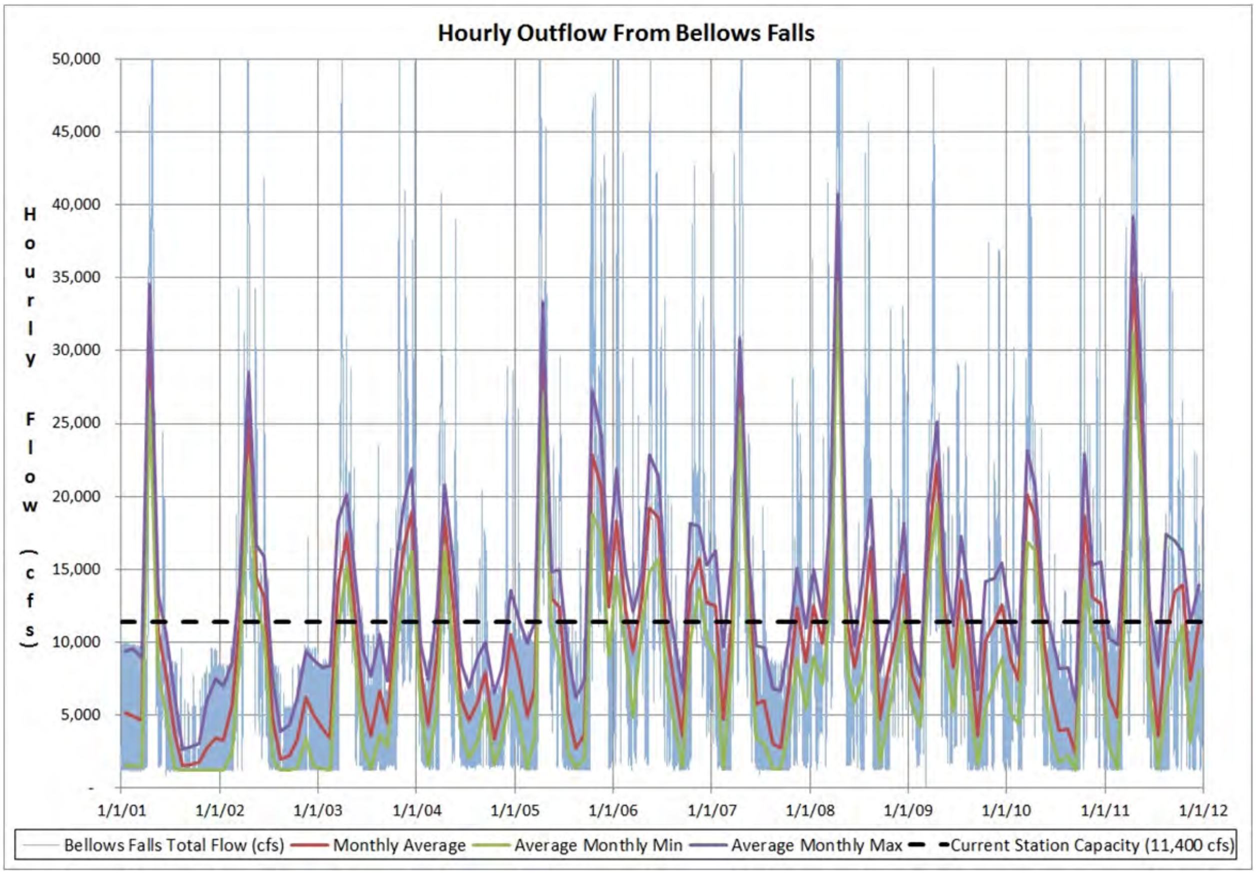


Figure 3.5-5. Exceedence curves for October, November, and December (Source: USGS, 2012, as modified by TransCanada).

Table 3.5-1. Monthly minimum, average, and maximum flow values (cfs) (Source: USGS, 2012, as modified by TransCanada).

Month	Minimum	Year	Average	Maximum	Year
January	2,588	1981	8,617	20,573	2006
February	2,697	1980	7,846	21,499	1981
March	5,053	2001	14,809	33,660	1979
April	7,690	1995	26,385	40,676	2008
May	7,137	1995	15,795	32,899	1972
June	3,038	1999	8,765	20,972	2006
July	1,896	1991	5,884	18,654	1973
August	1,631	2001	5,150	17,803	2008
September	1,533	1995	4,336	13,056	2011
October	1,810	2001	8,408	2,550	2005
November	2,771	2001	10,332	22,794	2005
December	2,659	1978	10,258	22,440	1983

When inflows are less than the station capacity of 11,400 cfs, TransCanada operates the Project as a daily peaking project to help meet regional electrical demand. During all times, TransCanada's first priority is meeting the minimum flow requirement of 1,083 cfs while maintaining the reservoir within the operational range. Figure 3.5-6 graphs hourly outflow as compared to the monthly minimum, average, and maximums. This figure shows that outflows from the Project are normally between 1,100 and 11,400 cfs other than during high flow events that are most common in the spring and early fall.



Note flows above 50,000 cfs are not shown in the above figure.

Figure 3.5-6. Averaged hourly outflow and averaged monthly minimum, maximum and average outflow from the Project (January 1, 2001 – December 31, 2011) (Source: TransCanada, 2012, as modified by staff).

3.5.3 Water Use

TransCanada does not propose any substantial changes to the historical operations and proposes to continue the existing operations of the Project for hydropower generation. The existing license issued in 1979 requires a continuous minimum flow release of 1,083 cfs through the powerhouse area, or inflow if less.

There is limited use of surface water from the Bellows Falls impoundment for consumption, irrigation, municipal water supply or industrial uses; residential use for seasonal irrigation does occur. New Hampshire requires registration of water withdrawals more than 20,000 gallons per day averaged over 7 days or a total of more than 600,000 gallons per day in a 30-day period. In Walpole, New Hampshire, there are two groundwater sources for public supply in the aquifer near the Connecticut River, which may be influenced by infiltration from the Connecticut River (CRJC, 2009). Vermont does not have a system of tracking water withdrawals from the Vermont side of the river.

3.5.4 Water Rights

Currently there are no registered water withdrawals from the Connecticut River within the Project affected area, and TransCanada is not aware of any other water rights within the Project affected area.

3.5.5 Water Quality Standards

The state boundary between New Hampshire and Vermont is the low-water mark on the western side of the Connecticut River as it existed before the creation of reservoirs on the river. Because discharges from Project facilities occur in both states, the Project is subject to the water quality standards of both states.

Federal Clean Water Act

In 1972, the Federal Water Pollution Control Act Amendments established the Clean Water Act as the foundation of modern surface water quality protection in the United States. Sections 303 and 305 of the Act guide the national program on water quality. Four subparts of Section 303 are relevant to this water quality discussion – Sections 303(a-c), which discuss the process by which all states are to adopt and periodically review water quality standards and Section 303(d) which directs the states to identify waters of the state that do not meet water quality standards and to develop plans (Total Maximum Daily Loads [TMDLs]) to bring those waters into compliance. Section 305(b) directs states to periodically prepare a report that assesses the quality of surface and ground waters in the state.

State Standards

Vermont

Vermont water quality standards serve as the foundation for protecting Vermont's surface waters. The current standards became effective December 30, 2011 (Vermont DEC, 2011a). Surface waters in Vermont are presently classified as Class A(1), Class A(2), or Class B based on numerical or narrative criteria to protect the designated uses. Waters designated as Class A(1) are Ecological Waters that are managed to maintain an essentially natural condition. Class A(2) waters are Public Water Supply waters that are managed for the natural condition with the exceptions of withdrawals for public water supplies. Class B waters are managed to achieve and maintain a level of quality that fully supports multiple designated uses. Applicable water quality standards and the associated designated uses for Class B waters in Vermont are shown in table 3.5-2. Vermont's water quality monitoring program emphasizes biomonitoring (an ambient monitoring program started in 1982) and also measures physical and chemical aspects of water bodies (Vermont DEC, 2010; CRJC, 2009).

Currently the Connecticut River is designated as Class B water in Vermont and as a coldwater fish habitat. Table 3.5-2 shows applicable water quality standards for Class B waters in Vermont.

Table 3.5-2. Vermont water quality standards applicable to Project waters (Source: Vermont DEC, 2011[a]).

Class	Designated Uses	Dissolved Oxygen (DO)	pH	Bacteria (E. coli)	Nutrients
B	Aquatic biota, wildlife and aquatic habitat, aesthetics, public water supply with filtration and disinfection, irrigation of crops, primary contact recreation, boating, fishing, other recreation.	For coldwater fish habitat waters, not less than 6 mg/l and 70% saturation	Between 6.5 and 8.5	Not to exceed 77 per 100 ml in one sample; may be waived by permit condition between October 31 and April 1.	Total phosphorus loadings limited so as to not accelerate eutrophication or the stimulation of the growth of aquatic biota in a manner that prevents full support of uses; Nitrates not to exceed 5.0 mg/l as NO_3-N at flows exceeding low median monthly flows.

[a] For areas determined by the Secretary to be salmonid spawning or nursery areas, no less than 7 mg/L and 75 percent saturation, nor less than 95 percent saturation during late egg maturation and larval development.

Vermont water quality standards also include qualitative and semi-quantitative criteria for turbidity, alkalinity, taste and odor, toxics and temperature (based in part on whether the waters are designated for cold or warmwater fish habitat), and for aquatic biota, wildlife and aquatic habitat. These standards are generally not applicable to, nor influenced by, Project generation-related operations. Some of these standards are included in the Project's National Pollutant Discharge Elimination System (NPDES) permit (see section 3.5.6.5) and others like turbidity and suspended solids are subject to NPDES construction stormwater permit requirements and are monitored and controlled as applicable to construction related work.

New Hampshire

NH-Env-Wq 1700 Surface Water Quality Regulations, readopted with amendments in 2008, fulfill the section 303 requirements of the federal Clean Water Act. Surface waters are routinely sampled to assess compliance with the standards as part of New Hampshire's Surface Water Quality Assessment Program. Water quality standards are used to protect the State's surface waters with the overall goal that all surface waters attain and maintain specified standards of water quality to achieve the purposes of the legislative classification. Standards consist of three parts: designated uses, such as fishing or swimming; numerical or narrative criteria to protect the designated uses; and an antidegradation policy, which maintains existing high quality water that exceeds the criteria. Criteria are established by statute (Title L Water Management and Protection, Chapter 485-A Water Pollution and Waste Disposal) and by administrative rules (Env-Wq 1700).

Surface waters in New Hampshire are classified as Class A or Class B. Class A waters are of the highest quality and are managed to be potentially acceptable for water supply uses after adequate treatment. Class B waters are of the second highest quality and are managed to achieve and maintain certain designated uses. The Connecticut River has been designated a Class B water by the New Hampshire General Court. Applicable water quality standards and the designated uses for Class B waters in New Hampshire are listed in table 3.5-3.

Table 3.5-3. New Hampshire water quality classification standards applicable to Project waters (Source: Chapter 485:A, Water Pollution and Waste Disposal, Classification of Waters and Env-Wq 1700 Surface Water Quality Regulations).

Class	Designated Uses	Dissolved Oxygen (DO)	pH	Bacteria (E. coli)	Nutrients	Other
B	Acceptable for fishing, swimming, other recreation, and water supply use after adequate treatment.	At least 75% saturation, based on a daily average; instantaneous minimum of 5.0 mg/l	6.5 to 8 unless due to natural causes	Geometric mean of 3 samples over 60-day period, not to exceed 126 per 100 ml, or no greater than 406 per 100 ml in one sample [a]	No phosphorus or nitrogen in such concentrations that would impair any existing or designated uses, unless naturally occurring.	No discharge of sewage or wastes into waters unless treated to prevent the lowering water quality to below these standards and such disposal may not be inimical to or maintenance of aquatic life.

[a] For designated beach areas, geometric mean not to exceed 47 per 100 ml or 88 per 100 ml in a single sample, unless naturally occurring.

New Hampshire standards also include criteria for turbidity, alkalinity, taste and odor, toxics, and temperature based on whether the waters are designated for cold or warmwater fish habitat and for aquatic biota, wildlife, and aquatic habitat. These standards are generally not applicable to, nor influenced by, Project generation-related operations. Some of these standards are included in the Project's NPDES permit (see section 3.5.6.5) and others like turbidity and suspended solids are subject to NPDES construction stormwater permit requirements and monitored and controlled as applicable to construction-related work.

3.5.6 Existing Water Quality

The Connecticut River within the Project area displays water quality characteristics typical to a large New England river. The water quality of Project waters is consistent and in compliance with Class B standards. The sources of information used to describe the water quality at, or in the vicinity of, the Project are listed above in section 3.5.1.

3.5.6.1 Relevant Water Quality Data

In 2004, at the request of the Connecticut River Joint Commissions (CRJC), New Hampshire DES, assisted by the U.S. Environmental Protection Agency (EPA), conducted a water quality study on the 275 miles of the river between the Canadian and Massachusetts borders in anticipation of the 2005 update of the Connecticut River Corridor Management Plan (CRJC, 2009). This data set remains the most comprehensive and definitive dataset available for the Connecticut River. Samples were taken during the months of June through August, and in some cases, September. Data relevant to the Project are summarized in table 3.5-4. It is recognized that the Sumner Falls and Lebanon sites are outside the Project affected area. However, they are included here because they are upstream and provide an indication of the quality of water that may on occasion influence Project waters. Most sites sampled were found to be fully supporting the designated uses of aquatic life, and primary and secondary contact recreation as defined by the New Hampshire Surface Water Quality Regulations (Env-Wq 1700). The Route 11 Bridge at Charlestown site was noted to be not supporting for aquatic life due to the presence of invasive species. The Route 89 Bridge in Lebanon and the Railroad Bridge in West Lebanon were noted as not supporting for primary contact recreation due to combined sewer overflows (CSOs) in Lebanon, New Hampshire. The CSO problem in Lebanon has been negotiated with New Hampshire DES. Since the 2004 sampling, three out of the seven CSOs in Lebanon have been eliminated, with the goal of total elimination by 2020 (New Hampshire DES, 2012a).

Table 3.5-4. Water quality data collected in support of the New Hampshire DES Connecticut River Water Quality Assessment Project (Source: CRJC, 2009).

Location (Collection Site Designation)	DO (mg/L) low/high	DO (%Sat.) low/high	pH low/high	Temp (°C) low/high	Bacteria GeoMean (#/100ml)
Bellows Falls Dam Bypass Reach (NHRIV801070501-10-01)	7.89 / 9.79	89.5 / 105.5	7.09 / 8.01	15.2 / 24	40.3
Arch Street Bridge, Walpole NHIMP801060703-05	7.23 / 9.54	88.0 / 96.6	6.71 / 7.61	15.5 / 25.3	19.5
Route 11 Bridge, Charlestown	7.73 / 9.65	89.0 / 96.5	7.43 / 7.72	15.5 / 25	18

Location (Collection Site Designation)	DO (mg/L) low/high	DO (%Sat.) low/high	pH low/high	Temp (°C) low/high	Bacteria GeoMean (#/100ml)
NHRIV801060702-12					
Route 12/103 Bridge, Claremont NHRIV801060305-12	7.91 / 8.46	85.5 / 96.2	6.8 / 7.71	18.3 / 23	28
Sumner Falls, Plainfield NHRIV801060302-05	7.28 / 8.5	82.3 / 95.6	6.52 / 7.82	19.7 / 22	66
Route 89 Bridge, Lebanon NHRIV801060302-01	6.64 / 9.42	85.4 / 96.6	6.64 / 7.67	16.7 / 23	21.3
Railroad Bridge at Blue Seal, West Lebanon NHRIV801060302-05	6.71 / 8.65	85.1 / 92.4	6.66 / 7.58	18 / 22	67
Route 4 Bridge, West Lebanon NHRIV801040402-13	6.84 / 8.27	84.4 / 94.8	6.76 / 7.49	19.1 / 21	21

In another study, the University of Massachusetts Water Resources Research Center, working with the Targeted Watershed Initiative (TWI), sampled a 14-mile stretch of the Connecticut River for bacteria twice a week during high-use recreation summer months of 2008 and 2009 (TWI, 2010). Ten sampling stations were located between the Wilder Picnic Area in Hartford, Vermont (immediately upstream of Wilder dam and about 40 miles upstream of Bellows Falls dam), and the Wilgus State Park in Weathersfield, Vermont (21 miles upstream of the Project dam. The results are discussed here to provide an indication of the bacterial quality of water that might at times be entering and influencing the Bellows Falls Project waters.

The sites were designated to document the effectiveness of the CSO reductions in Lebanon, New Hampshire, and the elimination of the six CSOs in Hartford, Vermont in 2007. The geometric means for the 14 mile stretch of water sampled during this study were below the bacterial water quality standard for primary contact recreation of 126 per 100 ml, although the water quality standard was exceeded for a single sample at two locations in 2008 and at two locations in 2009 under wet conditions. For all sampling sites except one, wet weather bacterial counts were higher than dry weather counts. At three locations, a single sample (out of 27 samples) exceeded the New Hampshire Water Quality Standards single sample maximum of 400 per 100 ml: East Wilder Boat Launch, West Lebanon (520 per 100 ml); Lyman Point Park, Hartford (480 per 100 ml); and, Blood Brook Canoe Launch, Lebanon (416 per 100 ml). No site reported more than one exceedence.

The USGS National Water Information System has made available real-time, current and historic surface water quality records from its streamflow gages located in West Lebanon, New Hampshire (immediately downstream of the White River confluence, just below the Route 4 bridge), and just downstream of the Project area at North Walpole, New Hampshire (just upriver of the Cold River confluence). These data are displayed in table 3.5-5.

Table 3.5-5. Water quality data in the vicinity of the Project, provided by the USGS National Water Information System (Source: USGS, 2012a)

Location	Date	Temp °C	Sp Cond uS/cm	DO mg/L	pH	Total N (unfiltered) mg/L	Phosphorus (unfiltered) mg/L
West Lebanon							
	4-12-05	3	76	14.1	7.3	0.57	0.059
	8-08-05	24	160	7.7	7.6	0.41	0.006
	10-25-06	10.8	82	11.8	7.2	0.43	0.015
	12-14-06	2.8	106	12.6	7.4	0.45	0.012
	2-07-07				7.0	0.54	0.011
	3-28-07		84		7.1	0.78	0.133
	4-19-07		81		7.2	0.61	0.089
	5-16-07	13.7	84	10.2	6.9	0.51	0.013
	6-27-07	22.4	129	7.1	7.5	0.42	
	8-01-07	24.8	134	8.3	7.6	0.38	0.009
	9-05-07	22.8	145		7.2	0.38	0.006
North Walpole							
	4-18-05	7.2	108	11.9	7.2	0.41	0.009
	8-11-05	26.7	141	6.9	7.4	0.36	0.006
	10-25-06	9.5	87	9.8	7.0	0.44	0.018
	12-14-06	2.6	116	13.1	6.9	0.47	0.010
	2-07-07				7.0	0.57	0.012
	3-28-07		86		7.0	0.84	0.152
	4-19-07		81		6.6	0.64	0.194

Location	Date	Temp °C	Sp Cond uS/cm	DO mg/L	pH	Total N (unfiltered) mg/L	Phosphorus (unfiltered) mg/L
	5-16-07		96	9.5	6.9	0.44	0.011
	6-27-07	23.5	142		7.4	0.42	0.011
	8-01-07	25.9	125	8.0	7.2	0.38	
	9-05-07	22.3	136		7.7	0.42	0.009

The data display the typical seasonal and annual fluctuations in water quality conditions expected for surface waters in this area, although nitrogen levels, as measured by total N, reflect somewhat enriched conditions. Relatively high concentrations of both nitrogen and phosphorus measured in March and April 2007 at both gages likely reflect elevated levels of suspended materials in the water associated with spring runoff conditions and therefore may not be representative of typical water quality.

3.5.6.2 TransCanada Water Quality Studies

In recognition of the fact that there was little current, comprehensive, Project-specific water quality data available, TransCanada undertook a comprehensive water quality study during the summer of 2012. Both New Hampshire DES and Vermont DEC reviewed and contributed to the study plan.

Water quality data were collected for the Project from June 20, 2012 through September 12, 2012. Monitoring stations are shown on figure 3.5-7. Temperature, specific conductivity, pH, and dissolved oxygen (DO) were continuously monitored with a YSI model 6920 multiparameter sonde below Bellows Falls dam in the tailrace area for the entire study period (Station BF-TR). From week 4 through the end of the study, additional continuous monitors were installed above the dam at Station BF-01 at a depth within the upper 25 percent of the impoundment (about 8 feet deep) as well as below the dam in the bypassed reach at Station BF-BR which also recorded temperature, specific conductivity, pH, and DO data. All stations were located in New Hampshire waters.

Beginning at week 4 and continuing through the end of the study, weekly water samples were collected from Station BF-01 and analyzed for nitrate/nitrite; total nitrogen; total phosphorous; total Kjeldahl nitrogen; and chlorophyll-a. The water samples were extracted by surface to near-bottom core and represent a composite of the entire water column.

Weekly water column profiles of temperature, specific conductivity, pH, and DO were recorded with a YSI model 6920 or 600 XLM multiparameter sonde in the Bellows Falls impoundment at Stations BF-01, BF-02, and BF-03 for the entire study period.

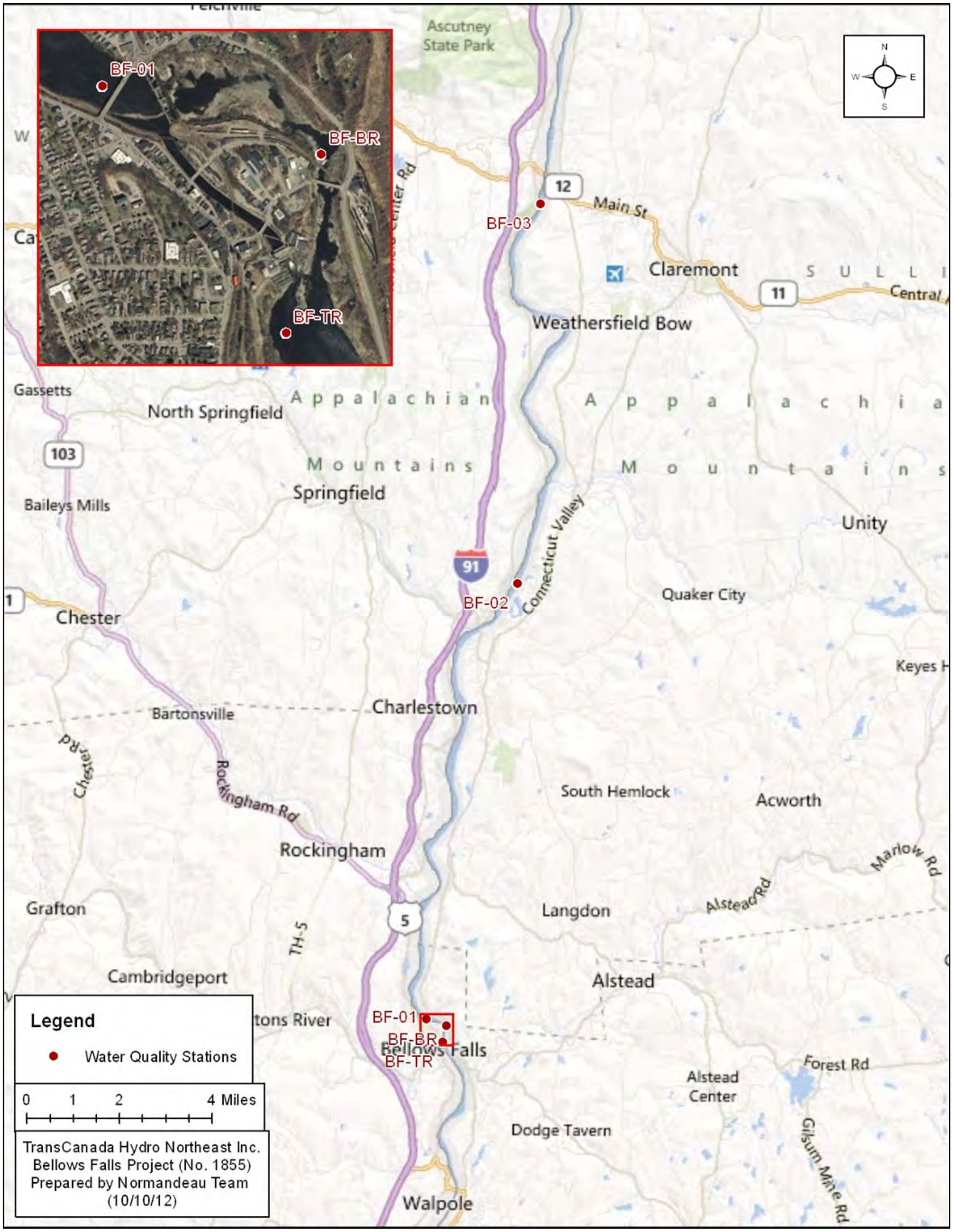


Figure 3.5-7. Map of study area showing monitoring stations. Inset map shows vicinity of Bellows Falls dam.

Tables 3.5-6 through 3.5-10 show statistical summaries of field measurements taken in the Project affected area, including maximum, minimum, median, and mean values for the datasets. The 24-hour rolling average for oxygen saturation (table 3.5-10) was prepared to determine compliance with New Hampshire state standards for DO saturation. Table 3.5-11 summarizes all laboratory analyses.

Table 3.5-6. Summary of temperature data.

Temperature (°C)	BF-03 (Weekly Profiles)	BF-02 (Weekly Profiles)	BF-01 (Weekly Profiles)	BF-01 (Continuous Monitoring)	BF-BR (Continuous Monitoring)	BF-TR (Continuous Monitoring)
Max	24.66	25.55	26.48	26.96	27.22	26.31
Min	18.72	19.43	21.00	21.30	20.86	20.79
Median	22.43	23.67	24.10	24.86	24.98	24.38
Mean	22.31	23.13	23.74	24.74	24.81	24.23

Table 3.5-7. Summary of specific conductivity data.

Specific Conductivity (µS/cm)	BF-03 (Weekly Profiles)	BF-02 (Weekly Profiles)	BF-01 (Weekly Profiles)	BF-01 (Continuous Monitoring)	BF-BR (Continuous Monitoring)	BF-TR (Continuous Monitoring)
Max	183	165	162	168	167	170
Min	107	111	118	114	115	118
Median	132	136	141	142	144	145
Mean	133	136	142	142	143	144

Table 3.5-8. Summary of pH data.

pH	BF-03 (Weekly Profiles)	BF-02 (Weekly Profiles)	BF-01 (Weekly Profiles)	BF-01 (Continuous Monitoring)	BF-BR (Continuous Monitoring)	BF-TR (Continuous Monitoring)
Max	7.76	7.77	7.68	8.53	8.06	7.61
Min	6.08	6.90	6.45	7.18	7.48	7.11
Median	7.21	7.55	7.46	7.71	7.69	7.33
Mean	7.17	7.47	7.40	7.68	7.72	7.34

Table 3.5-9. Summary of DO data.

Dissolved Oxygen (mg/L)	BF-03 (Weekly Profiles)	BF-02 (Weekly Profiles)	BF-01 (Weekly Profiles)	BF-01 (Continuous Monitoring)	BF-BR (Continuous Monitoring)	BF-TR (Continuous Monitoring)
Max	9.33	9.35	10.59	10.25	9.70	10.70
Min	7.41	7.11	3.26	5.94	5.97	6.48
Median	8.09	8.15	8.11	7.86	8.50	8.82
Mean	8.19	8.24	7.93	7.84	8.50	8.80

Table 3.5-10. Summary of oxygen saturation data.

Oxygen Saturation (% Saturation)	BF-03 (Weekly Profiles)	BF-02 (Weekly Profiles)	BF-01 (Weekly Profiles)	BF-01 (Continuous Monitoring)	BF-BR (Continuous Monitoring)	BF-TR (Continuous Monitoring)
Max	101.9	103.3	120.0	124.4	120.5	129.6
Min	87.5	85.7	39.0	72.8	74.4	78.5
Median	93.2	96.3	95.6	95.6	103.2	106.0
Mean	94.1	96.2	93.5	95.3	103.5	105.8
Minimum 24 hour average	NA	NA	NA	82.9	84.1	92.7

Table 3.5-11. Summary of laboratory analyses of weekly water samples from BF-01.

Date	NO3/NO2 (mg/L)	TN (mg/L)	TP (mg/L)	Chlorophyll-a (mg/m^3)	TKN (mg/L)
7/11/2012	0.16	0.53	0.012	3.8	0.37
7/18/2012	0.17	0.66	0.024	6.6	0.49
7/25/2012	0.20	0.61	0.010	2.7	0.41
8/1/2012	0.22	0.66	0.028	4.4	0.44
8/8/2012	0.21	0.83	0.039	3.5	0.62
8/15/2012	0.21	0.69	0.048	4.0	0.48
8/23/2012	0.15	0.58	0.009	2.9	0.43
8/29/2012	0.18	0.59	0.010	4.2	0.41
9/5/2012	0.16	0.56	0.012	3.1	0.40
9/12/2012	0.19	0.61	0.011	3.8	0.42
Mean	0.19	0.63	0.020	3.9	0.45

Impoundment Data

DO/oxygen saturation mean values generally decreased upriver to downriver, although variability increased. This likely resulted from increased algal activity which was evident in the diurnal changes in DO and pH. Similarly, pH variability increased upriver to downriver, but there was no significant trend in mean pH values. Temperature and specific conductivity increased slightly from the upstream to downstream stations. 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 algal activity.

Continuous Monitoring Data

Mean DO/oxygen saturation increased between the above-dam and below-dam stations. DO levels were greatest at BF-TR in the tailrace area and slightly lower at BF-BR in the bypass reach. Mean temperatures were highest at BF-CM and lowest at BF-BR with BF-01 falling in between. Mean pH was lowest at BF-CM while values at the other two stations were similar. Conductivity values were comparable between the three stations. Generally minor changes in above-dam to below dam values of study parameters likely reflect the differences between a whole-water column value, as would be found in the completely mixed environmental in the tailwater area versus a single point of measurement (approximately 8 feet deep) in the impoundment.

Applicable State Standards

The 2012 water quality data were within a range that is typical of large, good quality riverine systems in northern New England. Most DO/oxygen saturation and pH levels meet state standards for Vermont and New Hampshire, with a few exceptions. The minimum pH data in table 3.5-8 from BF-03 of 6.08, recorded on 7/11/12, and BF-02 of 6.45, recorded on 6/20/12, are slightly below the minimum values of 6.5 for both Vermont and New Hampshire. pH values also dropped to 6.43 at BF-03 on 9/5/12. These minimum values were recorded on a single day for each observation, and data from the surrounding days are above the state standard. Two of these samples were measured in the upper-most half of the impoundment and likely reflect episodic occurrences of lower pH associated with acidic atmospheric deposition. Bellows Falls impoundment is listed as impaired for pH by New Hampshire DES (see section 3.5.6.3), so occasional low pH values were not unexpected.

On 7/12/12, two 15-minute pH values at station BF-01 located just above the dam were slightly above the pH water quality standard of 8.5. It is believed that this exceedence was caused by algal activity, because DO levels were well above saturation at the time (approximately 120 percent) which is indicative of algal activity.

As table 3.5-9 shows, the minimum DO level of 3.26 at station BF-01 fell below the state standards of 6 mg/L for Vermont and 5.0 mg/L for New Hampshire. Concurrently, table 3.5-10 presents the minimum instantaneous value of oxygen saturation from the same station as 39.0 percent, which also fell below the oxygen saturation standard for Vermont (70 percent). Because the sample was an instantaneous spot measurement, compliance with New Hampshire standards for DO saturation (daily average of 75 percent saturation) could not be determined. It is unclear what the significance of this low DO reading was. It is clear that it was a real event in that DO values were also depressed throughout the water column. However, measurements taken one-half hour later in approximately the same location did not find any non-compliant water. In addition, continuous monitoring stations BF-01 and BF-BR recorded minimum DO saturation levels of 72.8 and 74.4, respectively; however, hourly average DO saturation values for these stations never were less than 75 percent so DO saturation was compliant with New Hampshire water quality standards.

There are no specified state standards for temperature and specific conductivity, but both parameters reflect natural variations and seasonality as expected. Composite water sample data did not exceed nutrient criteria for either state, although at this time Vermont is the only state that provides numeric criteria. New Hampshire only notes that phosphorus or nitrogen levels should not impair any existing or designated uses, unless naturally occurring. The 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.

3.5.6.3 Section 303(d) Listing, Non-compliant Waters and TMDLs

Under Section 303(d) of the Federal Clean Water Act, and in adherence with federal water quality planning and management regulations (40 C.F.R. Part 130), all states are required to develop lists of impaired or “Category 5” waters; commonly referred to as the “303(d) list.” The list includes lakes, ponds, rivers, and streams whose water quality do not meet state defined water quality standards. Each state’s list must be updated every two years and submitted to EPA for approval. The Clean Water Act requires TMDLs to be developed for waters on the list and to provide a schedule indicative of TMDL completion priority.

In recent history, all surface waters in Vermont and New Hampshire have been listed as non-compliant for mercury due to higher than desired mercury levels in fish. The primary source of mercury contamination is atmospheric deposition. In 2007, EPA approved the Northeast Regional Mercury TMDL (NEIWPCC, 2007). This TMDL addressed all fresh surface waters in Vermont and New Hampshire that were impaired for fish consumption use because of atmospheric deposition of mercury. Consequently all surface waters on the 2006 303(d) lists from both states that were listed as impaired for fish consumption due to mercury where atmospheric deposition is the primary source of mercury, were delisted and moved from Category 5 to Category 4A in 2008. Category 4A includes waters impaired or threatened by a pollutant(s), but for which a TMDL study has been completed and approved by EPA. Progress has been made toward reduced atmospheric mercury loading, but the approved management strategy for mercury is adaptive and iterative and may take many years before waters in both states meet water quality standards for mercury.

In New Hampshire, certain changes were made between 2010 and 2012 in the development of the 303(d) list (New Hampshire DES, 2012). Those changes affecting the Project include both the changes in reporting of mercury impaired waters (noted above) and bacterial impairments. In 2010, EPA approved the *New Hampshire Statewide TMDL for Bacteria-impaired Waters* (New Hampshire DES, 2010). Since the TMDL has been approved by EPA, New Hampshire DES has placed all assessment units included in the TMDL in impairment Category 4A instead of on the 303(d) list (or Category 5) for primary contact recreation (i.e., swimming) due to *E. coli* (fresh waters) and enterococcus (marine waters) and shellfishing due to fecal coliform (marine waters). In 2011, EPA approved the *Vermont Statewide TMDL for Bacteria-impaired waters* (Vermont DEC, 2011), which establishes allowable bacterial loadings for Vermont’s surface waters, provides documentation of impairments, and outlines the reductions needed to meet water quality standards.

Table 3.5-12 exhibits the New Hampshire DES and Vermont DEC listing of impaired or threatened waters within the Project area from 2010 and 2012 (draft). Tributaries to the Connecticut River are shown only if they are impaired at the mouth, adjacent to Project waters. Also shown is the length of river (where available) and designated use that is impaired, the type of impairment, the TMDL status and the source of impairment.

New Hampshire DES previously considered the entire Connecticut River in New Hampshire contaminated by PCBs (CRJC, 2009). Prior to 2008, New Hampshire DES listed the river as impaired for PCBs on their 303(d) list. There are no known current sources of PCBs to the Connecticut River, so contaminants found in fish result from either past pollution in the watershed or from atmospheric deposition (CRJC, 2009). In 2008, New Hampshire DES, in conjunction with staff from the New Hampshire Environmental Health Program, determined that the Connecticut River should be delisted for PCBs because listing should only have occurred if a fish consumption advisory had been issued for the river and no advisory was ever issued for PCBs. The river was listed in prior years because PCBs were detected in fish tissue from the Connecticut River. But further review of that data found that the levels detected fall below human health screening levels (New Hampshire DES, 2008). Consequently, New Hampshire DES no longer lists the Connecticut River as impaired for PCBs.

In the case of the Project waters listed above, the source of impairments is unknown or due to atmospheric deposition, CSOs, or sedimentation. As noted previously, Lebanon, New Hampshire, is continuing to remove the remaining CSOs from operation. Springfield, Vermont, removed its 13 remaining CSOs by the end of 2010; it is unclear why that portion of the Black River remains on the 2012 listing.

The sediment in Commissary Brook is coming from a small tributary to Commissary Brook just upstream from its confluence with the Connecticut River. New Hampshire DES found that the sediment deposits are attributable to exposed, sloughed banks of an intermittent gully draining a reclaimed clay extraction pit, and determined that the plume will persist until the site is stabilized. Erosion in this stream has caused turbidity violations in the Project impoundment and created a substantial delta of gravel, silt and clay in the Connecticut River. Changes in hydrology caused from removing trees to open the clay pit created the instability and failure of downstream embankments, according to the assessment (CRJC, 2009b). Vermont ANR and the State's Act 250 Environmental Board both granted permit approval for the clay extraction in the early 1990s. It is believed that clay extraction penetrated to the depth of shallow groundwater, converting the intermittent stream to a perennial stream. The presence of varved soils associated with glacial Lake Hitchcock (see section 3.4, *Geology and Soils*) appear to be a major contributing factor to the release of tons of sediment that have washed down the steep tributary stream into Commissary Brook and the Connecticut River (CRJC, 2009b).

Table 3.5-12. New Hampshire DES and Vermont DEC 303(d) listing of impaired or threatened waters within the Project vicinity.

Unit ID/Location	Size (mi)	Designated Use	Impairment	TMDL Priority	TMDL Schedule	Source Name
2012						
Bellows Falls Impoundment NHIMP801060703-5	1,720 acres	AL[1]	pH	Low	2019	Atmospheric Deposition-acidity
Commissary Brook, mouth to upstream VT13-10	0.2 miles	AL	Sediment	Low	2020+	Erosion
Blow Me Down Brook, mouth to upstream NHRIV801060303-11	0.29miles	AL	Aluminum	Low	2019	Unknown
WTF Sugar River from mouth to upstream NHRIV801060407-16	1.71 miles	AL	Aluminum, pH	Low, High	2019, 2016	Unknown
Black River, mouth to upstream VT10-11	2.5 miles	PCR[b]	E. coli	Low	2020+	Springfield CSO
Clay Brook, mouth to upstream NHRIV801060703-06	2.34 miles	AL[a]	Fish Bioassessment	Low	2021	Unknown
2010						
Bellows Falls Impoundment NHIMP801060703-5	1,720 acres	AL	pH	Low	2019	Atmospheric Deposition-acidity

Unit ID/Location	Size (mi)	Designated Use	Impairment	TMDL Priority	TMDL Schedule	Source Name
Commissary Brook, mouth to upstream VT13-10	0.2 miles	AL	Sediment	Low	2020+	Erosion
From RR Bridge, Lebanon to confluence with Mascoma River RIV801060302-01	1.40 miles	PCR	E. coli	NA[c]	NA	CSO
From confluence with Mascoma River to confluence with Blow Me Down Brook NHRIV801060302-05	14.47 miles	PCR	E. coli	NA	NA	CSO
Blow Me Down Brook, mouth to upstream NHRIV801060303-11	0.291miles	AL	Aluminum	Low	2019	Unknown
WTF Sugar River from mouth to upstream NHRIV801060407-16	1.71 miles	AL, PCR	Aluminum, pH, E. coli	Low, High	2019, 2016, 2010	Unknown
from confluence with Sugar River to confluence with Black River, VT NHRIV801060702-12	15.35 miles	AL	Non-native Invasive Plants	NP[d]	NP	Unknown
Black River, mouth to upstream VT10-11	2.5 miles	PCR	E. coli	Low	2018+	Springfield CSO
Clay Brook, mouth to upstream NHRIV801060703-06	2.34 miles	AL	Fish Bioassessment	Low	2021	Unknown

[a] Aquatic Life; [b] Primary Contact Recreation; [c] NA – No TMDL required because other enforceable measures will correct the impairment; [d] NP – Non-pollutant, no TMDL required.

3.5.6.4 Fish Tissue Contamination and Consumption Advisories

As noted above, the Connecticut River has been listed as impaired for certain toxics. At present, only mercury is considered to be a fish tissue contaminant that is found at high enough levels to present potential human health risks, and therefore warrants a fish consumption advisory. In New Hampshire, the following mercury advisory applies statewide, including Project waters, for all freshwater fish, except stocked trout:

- pregnant and nursing women and women who may get pregnant should consume no more than one 8-ounce meal per month of freshwater fish;
- children under age 7 should consume no more than one 4-ounce meal per month of freshwater fish;
- all other adults and children age 7 and older should consume no more than four 8-ounce meals per month of freshwater fish; and
- when eating bass, pickerel, white perch or yellow perch, limit consumption to fish 12 inches or less in length while following the above guidelines.

Vermont has a similar, albeit species-specific, statewide advisory that would apply to those Project waters that are under Vermont jurisdiction. Table 3.5-13 presents Vermont's fish consumption advisory.

Table 3.5-13. Vermont statewide fish consumption advisory.

General Advisory	Children and Women of Childbearing Age	Everyone Else
Brown Bullhead Pumpkinseed	No more than 5 meals/month	No Restrictions
Walleye	0 meals	No more than 1 meal/month
Lake Trout Smallmouth Bass Chain Pickerel American Eel	No more than 1 meal/month	No more than 3 meals/month
Largemouth Bass Northern Pike Yellow Perch (larger than 10 inches)	No more than 2 meals/month	No more than 6 meals/month

General Advisory	Children and Women of Childbearing Age	Everyone Else
Brook Trout Brown Trout Rainbow Trout Yellow Perch (smaller than 10 inches)	No more than 3-4 meals/month	No Restrictions
All Other Fish	No more than 2-3 meals/month	No more than 9 meals/month

3.5.6.5 Other Water Quality Considerations – National Pollutant Discharge Elimination System Permits

The Project was issued a NPDES permit in the mid-1990s and has held a valid discharge permit ever since. This permit allows the Project to discharge minor, non-generation related wastewaters, including non-contact cooling water from turbine bearings and air compressors and internal leakage in wheelpits and sumps. The Project is required to undertake quarterly sampling of its wastewaters and report the results of the sampling to the permitting authority, Vermont DEC. Permit parameters and limits for temperature, pH, and oil/grease are the same for all discharge outfalls as listed below:

- Temperature (<90° F);
- pH (6.5-8.5);
- Oil/grease (<20 mg/l, not required for non-contact cooling water); and
- Daily maximum flow limits vary per discharge outfall as noted below:
    - 0.576 million gallons per day (mgd) for S/N 001: Non-contact cooling water from the transformer cooling system (these are owned and operated by New England Power, but monitored by TransCanada and included in TransCanada's permit);
    - 0.023 mgd for S/N 002, S/N 009 and S/N 010: Bearing unit cooling water;
    - 0.260 mgd for S/N 003: Air compressor cooling water, sump waters, and other internal drainage waters after treatment via an oil water separator; and
    - 1.296 mgd for S/N 004: Wheel pit drainage waters during extremely high river flows.

TransCanada has never measured a permit exceedence at the Project.

There are also 28 wastewater treatment facilities within the Connecticut River watershed above the Project that discharge into the Connecticut River mainstem or its tributaries (table 3.5-14).

Table 3.5-14. Towns within the Connecticut River watershed, above the Project with wastewater treatment facilities.

Canaan NH	Lyndon VT
Colebrook NH	Ryegate VT
Stratford Village NH	St. Johnsbury VT
Stratford Mill House NH	Bradford VT
Groveton NH	Hanover NH
Northumberland NH	Lebanon NH
Lancaster NH	Hartford/White River Junction VT
Lancaster Grange NH	Quechee VT
Whitefield VT	Meriden Village, Plainfield NH
Bethlehem NH	Windsor Weston Heights VT
Littleton NH	Windsor Main VT
Lisbon NH	Claremont NH
Woodsville VT	Springfield VT
Lunenburg VT	Putney NH

3.5.7 Project Effects on Seasonal Variation of Water Quality

Bellows Falls dam modifies the physical environment of this section of the Connecticut River by increasing depth, time-of-travel (flushing rate), and in the lower portion of the impoundment, width. However, existing and newly collected water quality data indicate that the Project has no significant impact on the primary water quality parameter of concern, DO, or on other physical and chemical parameters.

3.5.8 References

Biodrawversity and The Louis Berger Group, Inc. 2012. Freshwater mussel survey in the Connecticut River of the Vernon, Bellows Falls, and Wilder Hydroelectric Projects. Report submitted to TransCanada Hydro Northeast Inc.

Brown, R.A. 2009. *Where the Great River Rises, An Atlas of the Connecticut River Watershed in Vermont and New Hampshire*, Rebecca A. Brown, (Editor.) A project of the Connecticut River Joint Commissions.

CRJC 2009. Update: Water Resources, Connecticut River Management Plan, Wantastiquet Region. Connecticut River Joint Commission, Charlestown, NH.

CRJC 2009a. Update: Water Resources, Connecticut River Management Plan, Mount Ascutney Region. Connecticut River Joint Commission, Charlestown, NH.

EPA (U.S. Environmental Protection Agency). 2012. National Rivers and Streams Assessment. Home. EPA, May 2011. Web. 30 Aug 2012. http://water.epa.gov/type/rsl/monitoring/riverssurvey/index.cfm. (accessed September 10, 2012).

NEIWPCC. 2007. Northeast Regional Mercury TMDL. Northeast States and the New England Interstate Water Pollution Control Commission. http://www.neiwpcc.org/mercury/mercury-docs/FINAL%20Northeast%20Regional%20Mercury%20TMDL.pdf (accessed September 7, 2012).

New Hampshire DES. 2012. Impairments Removed (I.E. Delisted) from the 303(d) List of Threatened or Impaired waters. NHDES Water Division, Surface Water Quality Assessment Program, Concord, NH. http://des.nh.gov/organization/divisions/water/wmb/swqa/2012/documents/2012-draft-303d-delisted.pdf (accessed September 7, 2012).

New Hampshire DES, 2012a. 2012 Section 305(b) and 303(d) Consolidated Listing and Assessment Methodology. NHDES Water Division, Surface Water Quality Assessment Program, Concord, NH. http://des.nh.gov/organization/divisions/water/wmb/swqa/documents/calm.pdf (accessed September 7, 2012).

New Hampshire DES. 2010. New Hampshire TMDL for Bacteria-impaired Waters. NHDES Water Division, Surface Water Quality Assessment Program, Concord, NH. http://des.nh.gov/organization/divisions/water/wmb/tmdl/documents/final-bacteria-tmdl-report.pdf (accessed September 7, 2012).

New Hampshire DES. 2008. Impairments removed (I.E. delisted) from the 303(d) list of threatened or impaired waters. NHDES Water Division, Surface Water Quality Assessment Program, Concord, NH. http://des.nh.gov/organization/divisions/water/wmb/swqa/2008/documents/appendix_10_removed_from_303d.pdf (accessed September 7, 2012).

TWI. 2010. Rapid Response Water Quality Monitoring and Public Awareness, Final Report. Tri-State Connecticut River Targeted Watershed Initiative. Water Resources Research Center, Blasidell House, University of Massachusetts, Amherst, MA.

USGS (U.S. Geological Survey). 2012. National Water Information System web page, Water Data for the Nation. Available at: http://nwis.waterdata.usgs.gov/nwis. (accessed July 27, 2012).

USGS. 2012a. U.S. Geological Survey National Water Quality Assessment Program. http://water.usgs.gov/nawqa (accessed September 7, 2012).

Vermont DEC. 2011. Vermont Statewide Total Maximum Density Load (TMDL) for Bacteria-impaired Waters. Vermont Natural Resources Board, Water Resources Panel, Montpelier, VT. http://www.vtwaterquality.org/mapp/docs/mp_bacteriatmdl.pdf (accessed September 7, 2012).

Vermont DEC. 2011a. Vermont Water Quality Standards. VT Code R. 12 004 052. Vermont Natural Resources Board, Water Resources Panel, Montpelier, VT. (accessed September 7, 2012).

Vermont DEC. 2010. Water Quality Monitoring Strategy 2010-2020. Watershed Management Division, Vermont Surface water Management Strategy Vermont Natural Resources Board, Water Resources Panel, Montpelier, VT. http://www.vtwaterquality.org/wqd_mgtplan/swms_WQMS.htm#designated (accessed September 7, 2012).

3.6 FISH AND AQUATIC RESOURCES

This section reviews existing information for the fish and aquatic resources within the Project affected area, defined for the purposes of this section as the Bellows Falls impoundment, 26 miles upstream of the Project dam, the riverine segment to approximately 6 miles downstream, and the confluence of the key tributaries. The Connecticut River is home to a diverse assemblage of fishes ranging from coldwater to warmwater species (Deen, 2009). The creation of reservoirs, such as the Bellows Falls impoundment, and land use changes have created substantial warmwater habitat. Anecdotal reports suggested fishing was greatly enhanced because of increased habitat in the area upstream of Bellows Falls dam after it was built (CRJC, 2009a). Waters below dams are generally cooler, so trout are often found there. Trout may also be found at the confluence of major tributaries with the mainstem river, such as at the mouth of the Cold River downstream of Bellows Falls dam. In the Project affected area, coldwater species such as trout and salmon, reside or migrate seasonally, and cool and warmwater species, such as walleye (*Sander vitreus*), bass, and perch, reside year round. The Connecticut River from the Passumpsic River down to the Massachusetts border (including the Project affected area) has an outstanding warmwater fishery that includes smallmouth (*Micropterus dolomieui*) and largemouth bass (*M. salmoides)*, walleye, chain pickerel (*Esox niger)*, yellow perch (*Perca flavescens*), and bullhead (*Amerius* spp.) Vermont Campground Association, http://www.campvermont.com/html/more_info/mi_fishing.htm).

3.6.1 Summary of Existing Resources

New Hampshire Fish and Game Department (New Hampshire FGD) biologists compiled lists of suggested fishing locations, though not site-specific, that identified the Connecticut River in southwest New Hampshire as fishing locations for American shad (*Alosa sapidissima*, below Bellows Falls dam), black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), brown bullhead (*A. nebulosus*), common carp (*Cyprinus carpio*), chain pickerel, fallfish (*Semotilus corporalis*), largemouth bass, northern pike (*E. lucius*), rock bass (*Ambloplites rupestris*), smallmouth bass, walleye, white perch (*Morone americana*), and yellow perch. Additionally, biologists identified the Connecticut River from Woodsville, New Hampshire south as suggested fishing location for American eel (*Anguilla rostrata*, New Hampshire Fish & Game, Suggested Fishing Locations (http://www.wildlife.state.nh.us/Fishing/fishing.htm).

Fish Stocking

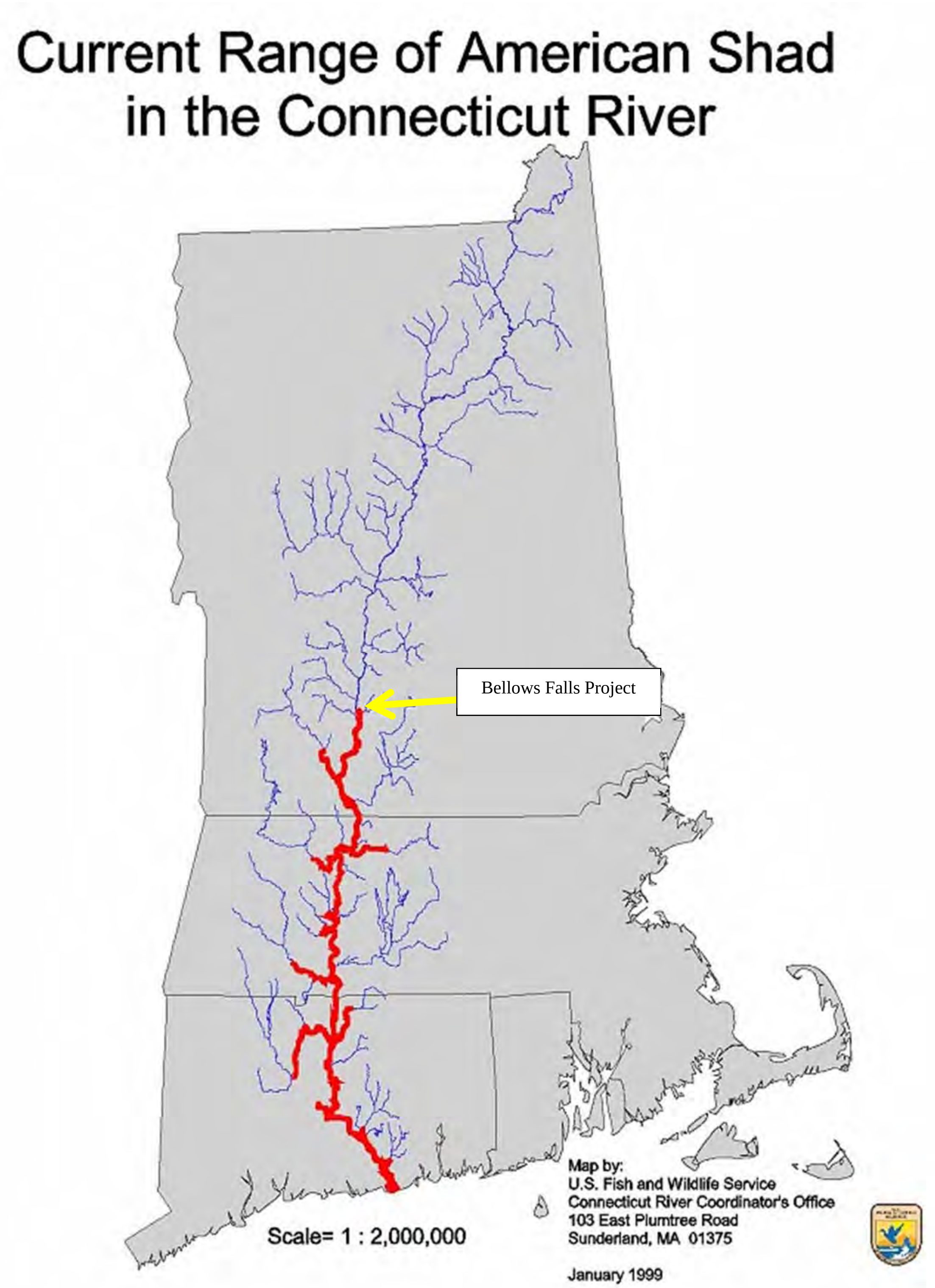
The Vermont Department of Fish & Wildlife (Vermont Fish & Wildlife) annually stocks brook trout (*Salvelinus fontinalis*) and rainbow trout (*Oncorhynchus mykiss*) into waters of the state including three major tributaries in the Project area: White River, Ottauquechee River, Williams River, and Saxtons River (Vermont Fish & Wildlife, 2009, 2010b). New Hampshire Fish & Game stocks brook trout, rainbow trout, and brown trout (*Salmo trutta*) in the following major tributaries to the Connecticut River in the Project affected area: Cold River, Mascoma River, and Sugar River (New Hampshire Fish & Game, 2009, 2010, 2011b). Trout stocked in the tributaries may move to the mainstem river seeking suitable habitat and enhance the fisheries there as well.

FWS has coordinated Atlantic salmon (*Salmo salar*) fry and smolt stocking since 1968. The annual stocking goal was 10 million fry per year, and since 2002 fry stocking has ranged from 6.0 – 7.8 million stocked annually to tributaries throughout the Connecticut River Basin (USASAC, 2011). However, in July 2012, FWS announced that it would no longer produce hatchery-reared salmon for the Connecticut River restoration effort based on low return rates.

Fish Passage

Diadromous fish species occurring in the Connecticut River include anadromous alosines, Atlantic salmon, and sea lamprey (*Petromyzon marinus*), and the catadromous American eel. Several of these species may occur in the Project affected area. The historic upstream extent of the range of American shad and blueback herring (*Alosa aestivalis*) in the Connecticut River is understood to be Bellows Falls due to the natural gradient of the river (Deen, 2009; Gephard and McMenemy, 2004; Castro-Santos and Letcher, 2010; figure 3.6-1). American shad, blueback herring, and sea lamprey passed or transported upstream of Vernon dam potentially continue to migrate upstream to the Project affected area, and in some years small numbers of American shad have passed upstream of Bellows Falls dam (Kart et al., 2005; FWS, 2012; tables 3.6-1 and 3.6-2). However, access to habitat upstream of the dam may be artificial due to the provision of fish passage upstream of the natural migration limit.

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 certain years, hundreds to thousands of sea lamprey have been recorded passing upstream of Bellow Falls dam (table 3.6-1), and in 2008 surveys, Yoder et al. (2009) documented sea lamprey just downstream of the confluence of the White River.



Source (FWS, Connecticut River Coordinators Office, (http://www.fws.gov/r5crc/Fish/histStuff/migmaps.html).

Figure 3.6-1. Current range of American shad in the Connecticut River.

Table 3.6-1. Annual upstream passage counts for the Vernon and Bellows Falls fish ladders (Source: Vermont FWD, 2010; Normandeau, 2011b; CRASC, http://www.fws.gov/r5crc/Fish/hist.html). American shad data include volitional passage at Vernon dam, and adult fish trapped at Holyoke dam and trucked and released upstream of Vernon dam.

	Vernon Dam Upstream Fish Passage					Bellow Falls Upstream Fish Passage		
Year	American Shad Passed	American Shad Trucked	Atlantic Salmon[a]	Sea Lamprey	Blueback Herring	American Shad	Atlantic Salmon	Sea Lamprey
1981	97		8	306	20			
1982	9		0	5	56			
1983	2,597		0	379	53			
1984	335		0	195	7	1	0	0
1985	833		4	1,257	21	0	2	10
1986	982		4	573	94	0	2	11
1987	3,459		10	667	0	39	8	35
1988	1,370		5	281	0	24	3	0
1989	2,953		0	205	49	*	*	*
1990	10,894		9	387	54	0	5	47
1991	37,197		6	750	383	65	3	34
1992	31,155		13	749	27	103	4	89
1993	3,652		7	627	28	2	0	17
1994	2,681		8	767	10	3	3	34
1995	15,771		5	509	115	147	1	44
1996	18,844		9	853	11	1	3	180
1997	7,384		4	1,506	6	46	0	40
1998	7,289		12	16,438	0	55	3	198
1999	5,097		8	836	0	110	2	195

	Vernon Dam Upstream Fish Passage					Bellow Falls Upstream Fish Passage		
Year	American Shad Passed	American Shad Trucked	Atlantic Salmon[a]	Sea Lamprey	Blueback Herring	American Shad	Atlantic Salmon	Sea Lamprey
2000	1,548	1,007	5	855	2	9	2	102
2001	1,744	71	1	3,212	0	**	1	**
2002	356	600	3	2,210	0	**	**	**
2003	268	869	0	8,119	0	*	*	*
2004	653	352	1	3,668	0	**	1	**
2005	167	596	4	3,669	0	3	3	229
2006	133	695	4	2,895	0	0	0	261
2007	65	495	5	17,049	0	0	3	709
2008	271	1,112	8	22,434	0	0	8	2233
2009	16	2,128	7	1,532	0	0	4	100
2010	290	1,545	8	3,179	0	0	4	392
2011	46	675	9	329	0	1	6	74
2012	10,715		4	696	0	0	2	99

[a] Based upon average or targeted release to upstream of Holyoke dam (RM 86) of 10 percent of returns.

* Fish ladder was not operated.

** Fish ladder was operated but not monitored; Atlantic salmon counts from radiotelemetry.

Table 3.6-2. Fish species occurrence in the Project affected area observed in primary resources reviewed.[a]

Species	Upstream	Downstream
American eel (*Anguilla rostrata*)	4, 2	
American shad (*Alosa sapidissima*)	5	5
Atlantic salmon (*Salmo salar*)	5, 6	5. 6
Black crappie (*Pomoxis nigromaculatus*)	2	
Blacknose dace (*Rhinichthys atratulus*)	4	

Species	Upstream	Downstream
Blueback herring (*Alosa aestivalis*)		
Bluegill (*Lepomis macrochirus*)	1, 2	
Bridle shiner (*Notropis bifrenatus*)		
Brook trout (*Salvelinus fontinalis*)		3
Brown bullhead (*Ameirus nebulosus*)	1, 4	
Brown trout (*Salmo trutta*)		1, 3
Chain pickerel (*Esox niger*)	1, 4	1
Common shiner (*Luxilis cornutus*)	1	1
Creek chub (*Semotilus atromaculatus*)	4	
Fallfish (*Semotilus corporalis*)	1, 2	1
Golden shiner (*Notemigonus crysoleucas*)	1, 2	
Largemouth bass (*Micropterus salmoides*)	1, 2	
Northern pike (*Esox lucius*)	1, 2	3
Pumpkinseed sunfish (*Lepomis gibbosus*)	1, 2	
Rainbow trout (*Oncorhynchus mykiss*)		3
Redbreast sunfish (*Lepomis auritus*)	1, 4	
Rock bass (*Ambloplites rupestris*)	1, 2	1, 3
Sea lamprey (*Petromyzon marinus*)	1, 5, 2	1, 5
Smallmouth bass (*Micropterus dolomieui*)	1, 2	1
Spottail shiner (*Notropis hudsonius*)	1, 2	
Tessellated darter (*Etheostoma olmstedi*)	1, 2	1
Walleye (*Sander vitreus*)	1, 2	1, 3, 7
White sucker (*Catostomus commersonii*)	1, 2	1
Yellow perch (*Perca flavescens*)	1, 2	1

[a] Project affected area defined here as extending about 26 miles upstream and 6 miles downstream of the dam. Documented occurrence indicated by a numeric reference in the species cell that corresponds to data source: 1: Yoder et al. (2009); 2: New Hampshire Fish & Game(unpublished data, G. Greis, personal communication); 3: New Hampshire Fish & Game creel survey log (http://www.wildlife.state.nh.us/Fishing/fisheries_management/walleye_survey.html); 4: NHFGD (http://www.wildlife.state.nh.us/Fishing/fishing_forecast/); 5: Vermont Fish & Wildlife (2010a); 6: Normandeau Associates (2011b); 7: Carrier and Gries (2010).

Varying numbers of American shad have been counted passing the Vernon fish ladder or were transported to the Vernon impoundment and would have been available in the Project affected area (see table 3.6-1). Blueback herring passage numbers have generally been low, and in recent years, non-existent. It is not known whether those fish that did pass Vernon dam would have used the Project affected area. Blueback herring abundance in the Connecticut River has declined significantly in recent years, and the species status is discussed in section 3.6.4. Studies of Atlantic salmon passage pertinent to the Project are discussed in section 3.6.2. Resident species have also been recorded using the Bellows Falls fish ladder. Those data are not currently available, but are being managed by Vermont Fish & Wildlife personnel and, for fish passage video data that have been processed should be available for distribution in the future (Lael Will, Vermont Fish & Wildlife, personal communication).

3.6.2 Summary of Existing Studies

Little comprehensive information is available regarding characterization of the fish community in relation to the Project; however, a few studies of greater scope include pertinent information. Note that species assemblage data are limited so information synthesized in this section may not be a full representation of species occurrence in the Project affected area.

Key sources used to characterize the fisheries resources in the Project affected area included:

- Fish Assemblage and Habitat Assessment of the Upper Connecticut River (Yoder et al., 2009).
- New Hampshire Fish and Game Walleye Creel Survey (Sprankle, 1997; Carrier and Gries, 2010).
- Connecticut River Fish Tissue Contaminant Study (Hellyer, 2006).
- Adult Atlantic Salmon Migration and Behavior Studies (Normandeau, 2011b).
- Project-specific Atlantic salmon smolt studies (RMC, 1991; 1992; Hanson, 1999).

Fish Assemblage and Habitat Assessment of the Upper Connecticut River

In 2008, an electrofishing survey of the Connecticut River was conducted as part of an EPA-funded project with the objective of assessing the relative abundance, composition, distribution, and general health of the fish assemblages as related to both historical and contemporary biological, chemical, and physical characteristics and stressors (Yoder et al., 2009). The 2008 sampling included standardized boat electrofishing at 46 discrete, approximately 1.0 km (0.62 mile) sampling locations for a cumulative effort of 44.74 km (27.8 miles). Seven of their sampling locations occurred in the Bellows Falls impoundment, from approximately 23.7 to 1.2 miles upstream. Only one station, 4.5 miles downstream, represented the Project affected area below Bellows Falls dam. Eighteen species were recorded occurring upstream of Bellow Falls dam and 10 species were recorded downstream (see table 3.6-2).

Yoder et al. (2009) made an initial assessment of the upper Connecticut River mainstem fish assemblages using three techniques: an Index of Biotic Integrity (IBI) developed for larger freshwater rivers of Maine, an IBI developed for the Atlantic slope (Daniels et al., 2005, as cited in Yoder et al., 2009), and a Modified Index of Well-Being (MIwb). The MIwb is a diversity index that incorporates two abundance and two diversity measures derived by the amount of fish and biomass. Highly tolerant species, hybrids, and exotic species are eliminated from the abundance (i.e., number and biomass) components of the formula. Although both the Maine Rivers IBI and the MIwb showed reduced index values for the station just upstream of the dam, the index value for the Atlantic slope IBI did not reflect a similar reduction. In all three indices, no trend was evident in the Project affected area, and the values within it were similar to those of the reaches upstream and downstream of it. While the Maine Rivers IBI and MIwb values in the Project affected area were lower than those far upriver (above RM 225) the same was not the case with the Atlantic slope IBI where values in the Project affected area were similar throughout the river (figure 3.6-2 below, consisting of three panels identified as A [figure 6], B [figure 7], and C [figure 8]). It is important to note that the gradient of the Connecticut River changes markedly from the upstream Wilder Project, transitioning from the high gradient upper river to a lower gradient that is relatively consistent through the Wilder, Bellows Falls, and Vernon Projects.

A.

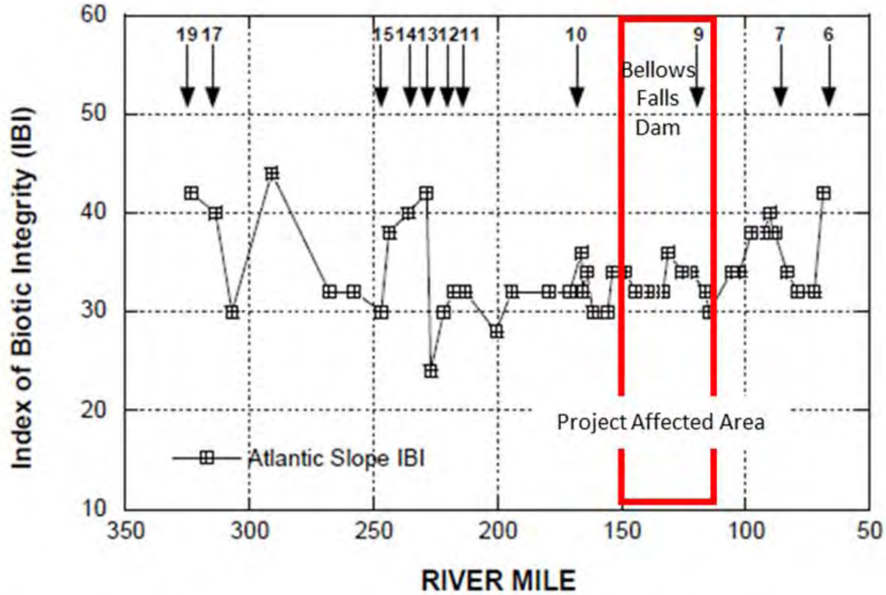


Figure 6. Atlantic slope Index of Biotic Integrity (IBI; Daniels et al. 2005) results in the upper Connecticut R. between Lake Francis and Turners Falls, 2008.

B.

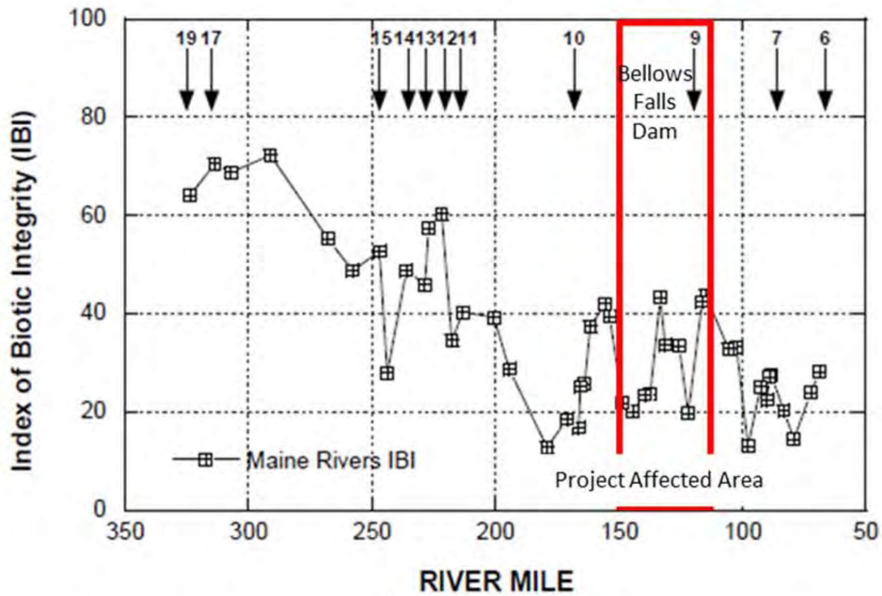


Figure 7. Interim Maine Rivers Index of Biotic Integrity (IBI; Yoder et al. 2008) results in the upper Connecticut R. between Lake Francis and Turners Falls, 2008.

C.

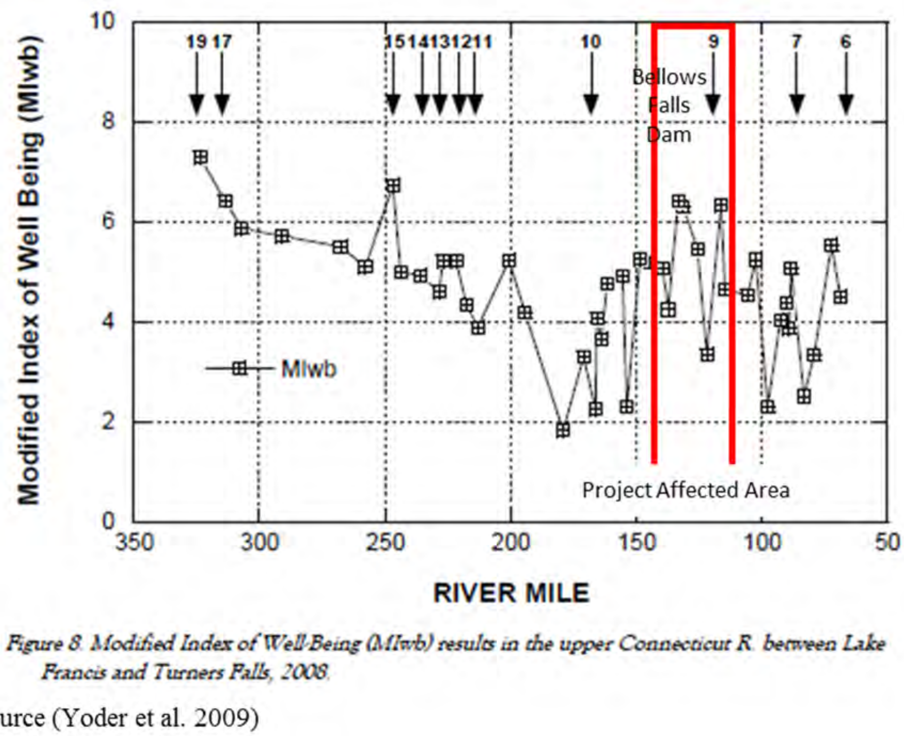


Figure 3.6-2. Results of Yoder et al. (2009) for the Connecticut River from Lake Francis to Turners Falls.[3] A. Atlantic slope Index of Biotic Integrity; B. Interim Maine Rivers Index of Biotic Integrity; C. Modified Index of Well-Being. Arrows labeled '9' indicate location of Bellows Falls dam. Red box indicates stations within the Project affected area.

New Hampshire Fish and Game Electrofishing Survey

From 1983 to 2011, New Hampshire Fish & Game conducted electrofishing sampling using standard boat electrofishing techniques in the mainstem Connecticut River and using backpack electrofishing techniques in selected tributaries. All surveys occurred during July through October. Species collected were recorded during general electrofishing surveys or as bycatch during surveys targeting young of the year bass and walleye. Those data were used to augment the list of documented species assemblage present in the Project impoundment (note that New Hampshire Fish & Game did not sample any stations in the Project affected area downstream of Bellows Falls dam) (see table 3.6-2). Two surveys were conducted each fall in either the Claremont or Charlestown reach in 1998 and 1999, 2002, 2004, 2005, 2006, 2007, 2008, 2009, and 2010, and one survey was conducted at North Walpole, in the Bellows Falls impoundment during summer 2007 (figure 3.6-3).

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[3] Note that river miles were measured from the head-of-tide not from the river mouth.

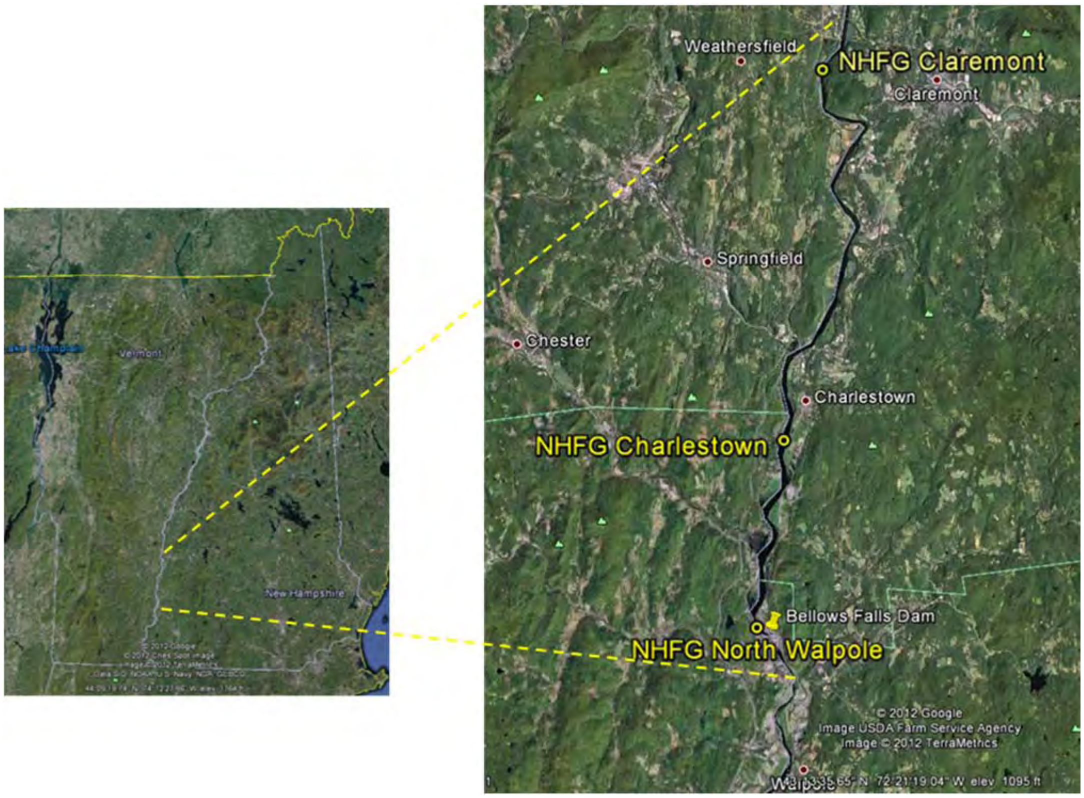

Figure 3.6-3. New Hampshire Fish & Game boat electrofishing sample locations in the Project area: Claremont, Charlestown, and North Walpole. Sample location coordinates and species collections data provided by G. Gries, New Hampshire Fish & Game (unpublished data).

New Hampshire Fish and Game Walleye Creel Survey

Walleye are not native to New Hampshire, but with initial stocking in the late 1800s quickly became established and common (New Hampshire Fish & Game, 1939, as cited in Carrier and Gries, 2010). The Connecticut River currently supports a naturally reproducing population of walleye from Monroe, New Hampshire (Comerford dam) south into the state of Connecticut (Carrier and Gries, 2010).

Carrier and Gries (2010) conducted a roving angler survey during spring (March - May) 2008 and 2009 in the southern New Hampshire portion of the Connecticut River including the Bellows Falls tailwater to the Cold River confluence and the Vernon Dam tailwater. Their objectives included comparison of angler survey results to a survey conducted in 1996, prior to current walleye regulations (Sprankle, 1997).

No significant differences in walleye total length (TL) were detected among years (figure 3.6-4); however, additional data were submitted by cooperating anglers. The combined data (cooperating angler information and creel survey information) were from a combination of the Bellows Falls, Vernon, and Wilder fisheries, with the majority of data from Wilder in 1995-1996, and Bellows Falls and Vernon in 2008 and 2009 (Carrier and Gries, 2010). The combined TL differed significantly among survey years (P = 0.006). Mean TL for both 2008 and 2009 were greater than for 1995/1996 data (Sprankle, 1997), but did not differ from each other (P > 0.05; figure 3.6-5).

The purpose of Carrier and Gries's (2010) study was to determine if fishery management objectives intended by 1998 regulations (a daily limit of 4 fish; no fish between 406 and 457 mm TL and only 1 fish larger than 457 mm TL can be harvested) were being met. They concluded that all measurable objectives (at the time of reporting) were met and the majority (93 percent) of anglers interviewed were supportive of the current walleye regulations on the Connecticut River.

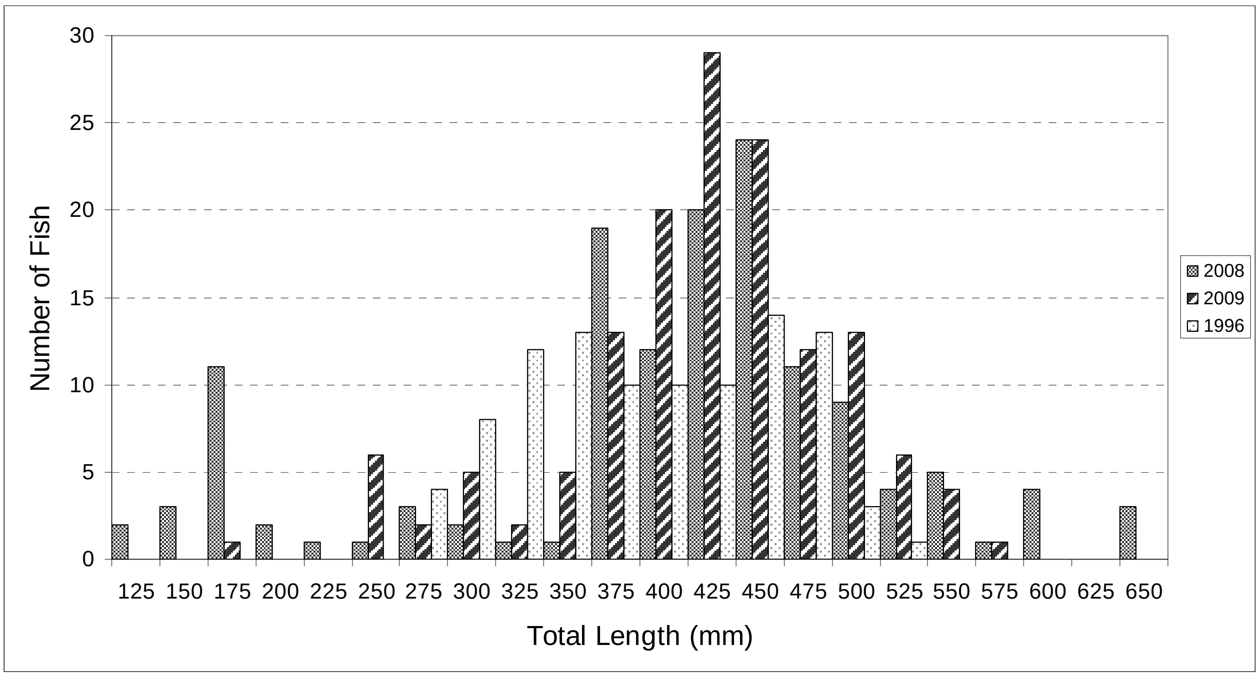

Figure 3.6-4 Length frequency distribution of walleye collected by creel survey and cooperating anglers in 1995-1996, 2008, and 2009 from the Wilder, Bellows Falls, and Vernon dam fisheries – combined (Source: Carrier and Gries, 2010).

Connecticut River Fish Tissue Contaminant Study

The Connecticut River Fish Tissue Contaminant Study (Hellyer, 2006) was designed to provide a baseline of tissue contaminant data from several fish species, to better understand the risk to human health from eating Connecticut River fish, and to learn what threat eating these fish poses to other mammals, birds, and fish. Their Study Reach 5 extended from above Vernon dam to Wilder dam, encompassing the Project affected area.

Three species of fish: smallmouth bass, white sucker *(Catostomus commersonii)*, and yellow perch, were evaluated. Hellyer (2006) concluded that mercury contamination posed a risk to recreational and subsistence fishers and to fish-eating wildlife. Total mercury concentrations in all three species were significantly higher in upstream reaches associated with higher elevation drainage basins that experience greater air deposition than in downstream reaches. Specifically, total mercury was higher in reach 7 (upstream of Moore dam) than all other reaches for all three species tested. For reach 6 samples, total mercury was similar to reaches downstream of it for smallmouth bass, but higher than reach 5 for yellow perch samples. Total mercury concentrations in white sucker samples from reach 6 were higher than all reaches downstream of it. Total mercury concentrations for samples from reach 5, which included but extended beyond the Project affected area downstream and upstream of Bellows Falls dam, were generally similar to more downstream reaches in all three species tested.

Besides evaluating contaminants, the study included examination of condition factor, a measure of the relative condition of a fish incorporating a weight to length ratio with higher values indicative of more robust fish in better condition, of smallmouth bass, white sucker and yellow perch among the seven reaches of the Connecticut River. The results included significantly higher condition factor for smallmouth bass in reach 5 as compared to all other reaches (figure 3.6-5); significantly higher yellow perch condition in reaches 5 and 6 compared to all other reaches (figure 3.6-6); and no significant differences in white sucker condition factor among reaches (figure 3.6-7; Hellyer, 2006).

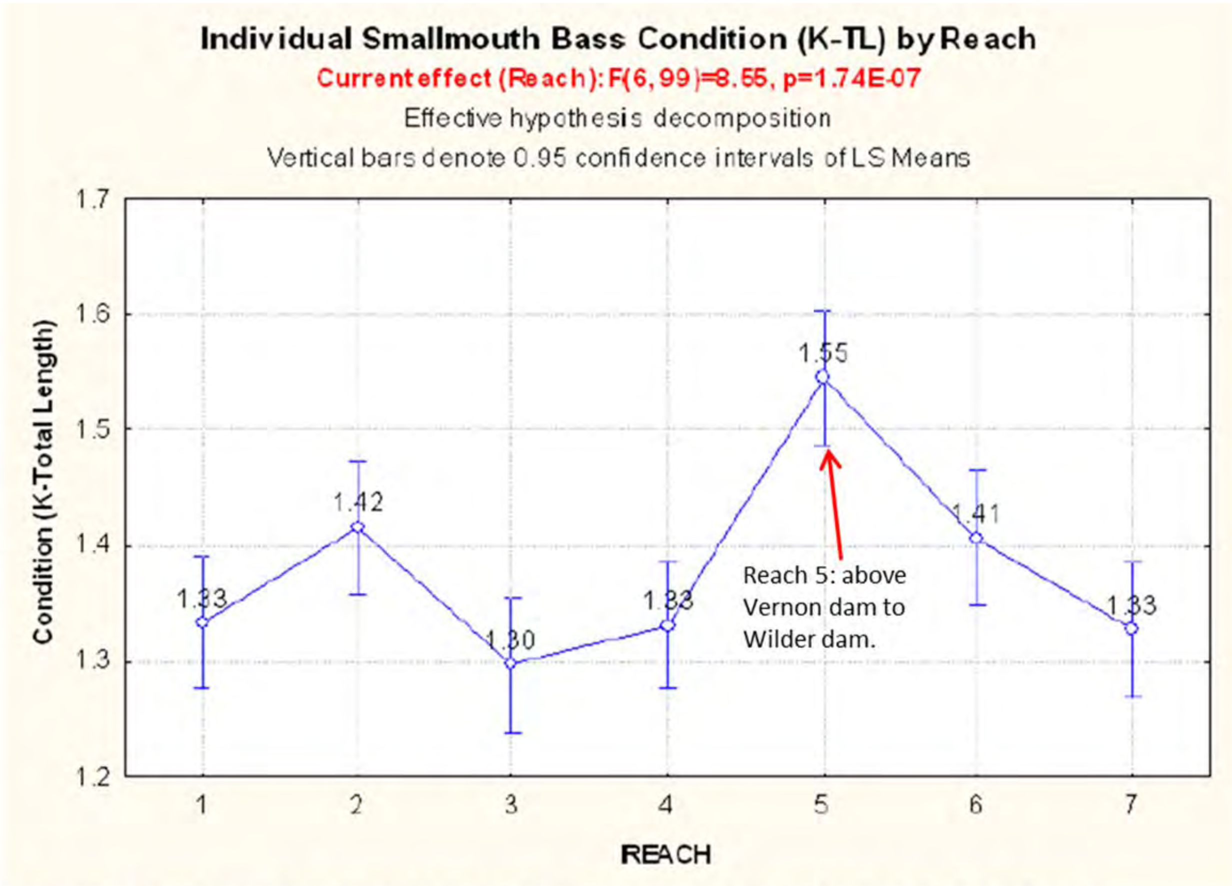

Figure 143. ANOVA of Individual Smallmouth Bass Condition (K-TL) by Reach

Source (Hellyer, 2006)

Figure 3.6-5. Results of Analysis of Variance of individual smallmouth bass condition by Connecticut River reach. Reach 5 = above Vernon dam to Wilder dam (Source: Hellyer, 2006).

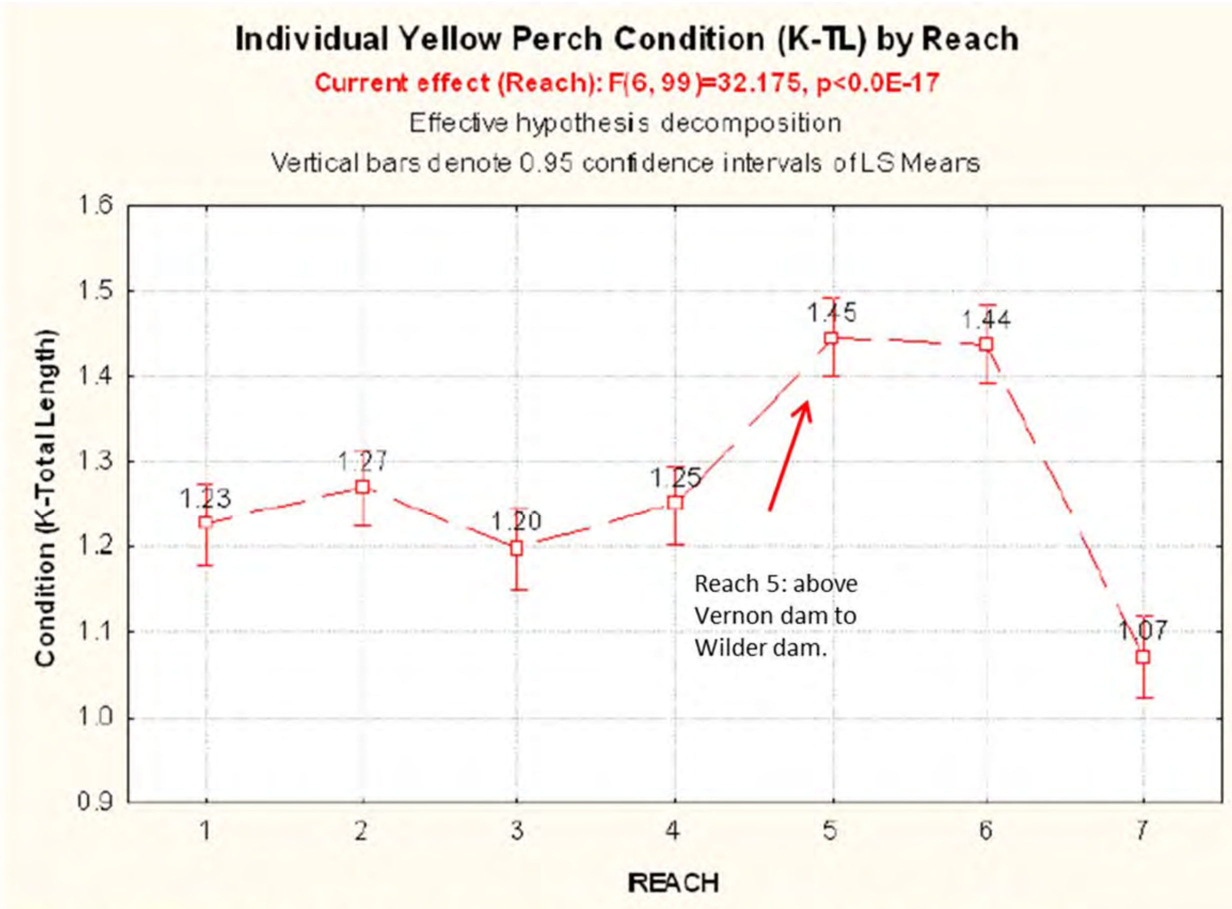

Figure 150. ANOVA of Individual Yellow Perch Condition (K-TL) by Reach

Source (Hellyer, 2006)

Figure 3.6-6. Results of Analysis of Variance of individual yellow perch condition by Connecticut River reach. Reach 5 = above Vernon dam to Wilder dam (Source: Hellyer, 2006).

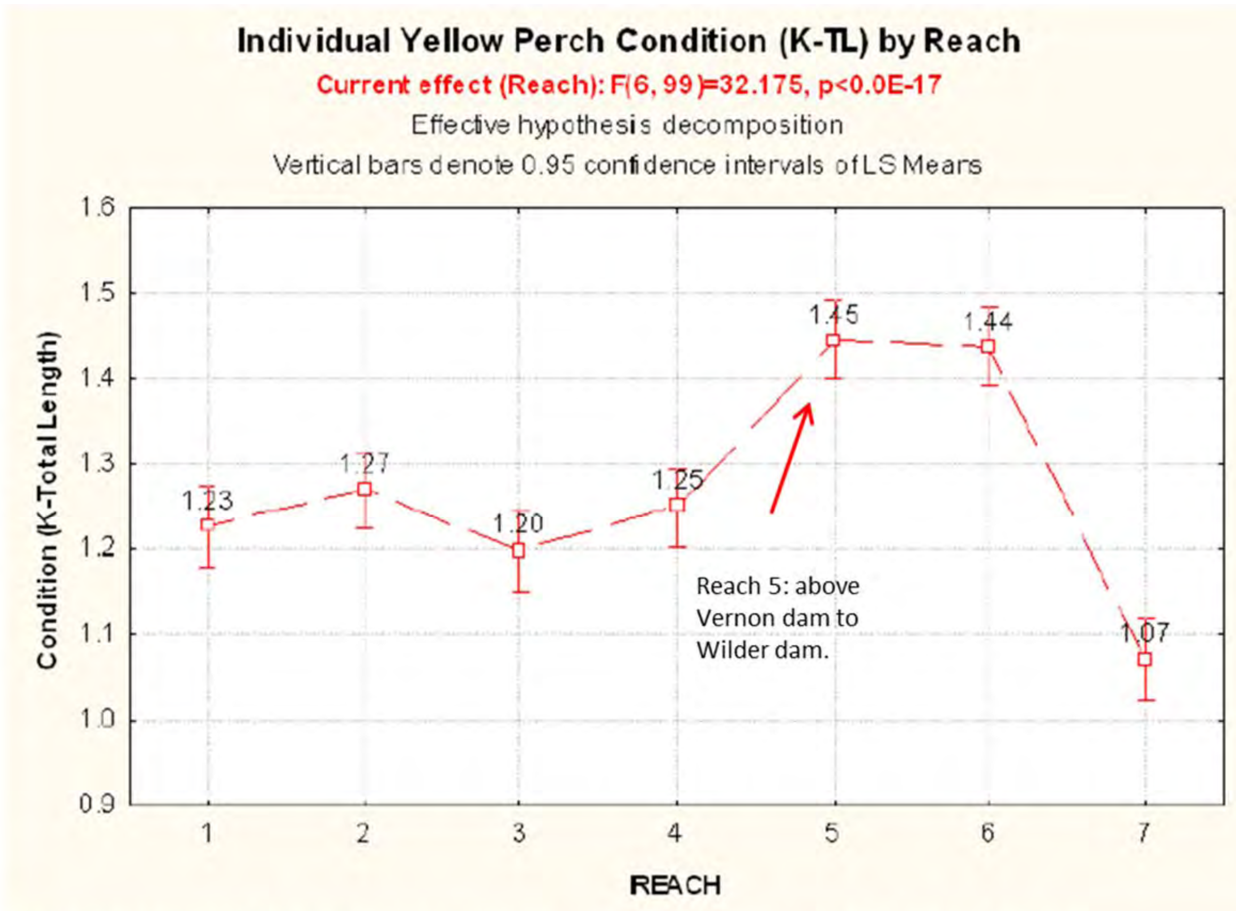

Figure 150. ANOVA of Individual Yellow Perch Condition (K-TL) by Reach

Source (Hellyer, 2006)

Figure 3.6-7. Results of Analysis of Variance of individual white sucker condition by Connecticut River reach. Reach 5 = above Vernon dam to Wilder dam (Source: Hellyer, 2006).

Atlantic Salmon Studies

A federal and multi-state cooperative program to restore American shad and Atlantic salmon to the Connecticut River basin was begun in 1967 and has evolved to include many other species. Restoration emphasis on the Connecticut River has been placed on fish passage at barrier dams, although marine survival, predation, genetic stock, climate change and other issues are contributive to restoration. Early Connecticut River fish passage was provided at Holyoke dam, Massachusetts (RM 86) in 1955, primary to provide passage for the existing American shad runs. Later, fishways were constructed upriver, including at Vernon, Bellows Falls, and Wilder dams to support future salmon runs (Gephard and McMenemy, 2004; see table 3.6-1). Vermont Fish & Wildlife and Normandeau have monitored adult Atlantic salmon utilization of the Bellows Falls fish ladder since 1998. Typically, few fish released back into the river because the majority are captured at Holyoke dam for hatchery brood stock with a goal of releasing 1 out of 10 returning adults (CRASC, 1998). Most sea-run released adult salmon have been radio-tagged largely due to a monitoring requirement associated with the Deerfield River Project (FERC No.2323) license. Such efforts have proven valuable for the entire Connecticut River basin and so have continued annually. Overall, from 1998 - 2011, 31 tagged salmon (21 percent of the total 146 tagged) used the fish ladder at Bellows Falls. Fifty-percent of all tagged salmon that passed Vernon dam also passed upstream of the Project (31 of 62; Normandeau, 2011b). Note that this is not an indication of passage effectiveness. Many Atlantic salmon that pass Vernon dam migrate up key tributaries, such as the West River or re-pass and move downstream at some point.

Behavior and movement studies of emigrating Atlantic salmon smolts at the Project began in 1991 with a survival evaluation of smolt passage through the existing ice/debris sluice (RMC, 1991), the designated downstream passage provision for emigrating salmon. Results indicated a 96 percent survival rate for smolts passing downstream via the sluice. Emigration studies of Atlantic salmon smolts initiated in 1992 for Wilder, Bellows Falls and Vernon Projects (RMC, 1992) allowed for monitoring of downstream passage route selection at Bellows Falls, and it was found that a disproportionate number of smolts passed through turbines instead of the bypass. In 1994, radio transmitter tagged smolts released for a Wilder Project study were also monitored at Bellows Falls to provide an evaluation of downstream passage. Passage success was not favorable and in response, plans were initiated to construct a diversion boom in the forebay of the powerhouse to divert emigrating smolts to the sluice bypass. A study was conducted in 1995 to determine the effectiveness of the new diversion boom (Hanson, 1999). Radio tagged smolts were released into the power canal upstream of the powerhouse and their passage route was determined using fixed station radio-telemetry techniques. A total of 94 percent of tagged smolts passed via the bypass, and combined with the survival rate of 96 percent yielded satisfactory downstream passage at the Project.

The Nature Conservancy Northeast Aquatic Connectivity Project

The Nature Conservancy conducted the Northeast Aquatic Connectivity (NAC) project with the primary ecological goal of mitigating fish passage barriers to enhance populations of fish including anadromous fish, coldwater species, and other species of greatest conservation need. The project was initiated to support resource agencies in efforts to strategically reconnect fragmented river, stream, coastal, reservoir, lake and estuarine habitat by removing or bypassing key barriers to fish passage (Martin and Apse, 2011).

The NAC used five metric categories: Connectivity Status, Connectivity Improvement, Watershed and Local Condition, Ecological, and Size/System Type. The metrics were calculated in geographic information system (GIS) and used to assess dams for their potential benefit to anadromous and resident fish, if dams were removed or bypassed. The project resulted in the development of two software tools available to interested users. The Northeast Aquatic Connectivity Tool was developed to execute the weighted ranking process that allows users to re-rank dams at multiple spatial scales (e.g., region, state, watershed), exclude dams that do not meet specific criteria, and modify the metric weights to develop new scenarios. The Barrier Analysis Tool is an ArcGIS 9.3 plug-in that facilitates several of the network calculations that were performed for the NAC project (Martin and Apse, 2011). The authors noted that their analysis only examines ecological criteria and does not incorporate social, political, economic, and feasibility factors critical to the evaluation of any dam mitigation project. They explicitly stated that "…these results should be used with caution and examined in the context of other relevant information. They are a screening-level tool and are not a replacement for site-specific knowledge" (Martin and Apse 2011, p. 14).

In the Connecticut River Basin, a total of 1,422 dams were evaluated in the analysis. Thirty-four percent of dams in the basin were in Vermont and New Hampshire with a density of one dam per 19 kilometers (11.8 miles) over 9,140 kilometers (5,679 miles) of river. One observation of the Project was that there were longer functional river networks in the Vermont and New Hampshire portions of the Connecticut River Basin than in the Massachusetts and Connecticut portions.

3.6.3 Conservation Plans

Vermont Wildlife Action Plan

In Vermont's Wildlife Action Plan (WAP), the fish species of greatest conservation need were identified (Kart et al., 2005). Criteria for selection included the degree of species rarity, species designated as at-risk, population trends, species whose habitat are vulnerable to loss, habitat fragmentation, habitat conversion or succession changes and species threatened by exotic plants or animals.

Several species listed in the Vermont WAP were either documented, known to use, expected to use, or have potential to be restored to use of habitats within the Project affected area. Diadromous species listed as species of greatest conservation need included sea lamprey, American eel (Vermont Species of Concern), blueback herring, American shad, and Atlantic salmon. Resident species included bridle shiner (*Notropis bifrenatus*, Vermont Species of Concern), blacknose shiner (*Notropis heterolepis)*, brook trout, and redbreast sunfish (*Lepomis auritus*) (table 3.6-3).

Table 3.6-3. Fish species listed in state conservation plans as species of greatest conservation need that occur in the Project affected area.

	State Conservation Plan Priority and status	
Species	**New Hampshire**	**Vermont**
American eel (*Anguilla rostrata*)	S5	S2, SC
American shad (*Alosa sapidissima*)	S3	S4
Atlantic salmon (*Salmo salar*)	S4	S4
Blacknose shiner (*Notropis heterolepis*)[a]		S1

	State Conservation Plan Priority and status	
Blueback herring (*Alosa aestivalis*)	S4	SU
Bridle shiner (*Notropis bifrenatus*)	S3, T	S1?,[b] SC
Brook trout (*Salvelinus fontinalis*)	S5	S5
Rainbow smelt (*Osmerus mordax*)	S5	
Redbreast sunfish (*Lepomis auritus*)		S4
Sea lamprey (*Petromyzon marinus*)	S4	S4/S5
Slimy sculpin (*Cottus cognatuson)*	S4/S5	
Tessellated darter (*Etheostoma olmstedi*)	S4	

Notes: Key to state rank: S1 = very rare (critically imperiled); S2 = rare (imperiled); S3 = uncommon (vulnerable); S4 = common (apparently secure); S5 = common (secure); SU = unrankable (lack of information).

Key to state status: SC = state species of special concern; T = threatened; E = endangered.

[a] Connecticut River from White River to Bellows Falls is listed as a possible watershed for blacknose shiner based on a single specimen collected from Springfield reservoir, Windsor County, Vermont.

[b] '?' denotes uncertainty in species status.

New Hampshire Wildlife Action Plan

New Hampshire has also identified species selected as those in greatest need of conservation in its WAP (New Hampshire Fish & Game, 2007). The species listed are similar to those of the Vermont plan but with some differences (see table 3.6-3). Notably, slimy sculpin (*Cottus cognatuson*) and tessellated darter (*Etheostoma olmstedi*) are included because they, along with Atlantic salmon, are the only three New Hampshire fish species identified to serve as hosts to the federally endangered dwarf wedgemussel (*Alasmidonta heterodon*) (Nedeau et al., 2000). Healthy populations of slimy sculpin in the Connecticut and Ashuelot rivers likely contribute to the persistence of dwarf wedgemussel populations in New Hampshire (New Hampshire Fish & Game, 2007). Additionally, bridle shiner is listed as threatened by the state of New Hampshire.

New Hampshire Inland Fisheries Operational Plan

The New Hampshire Fish & Game's Inland Fisheries Division's 2011 Master Operational Plan (New Hampshire Fish & Game, 2011a) is intended to convert fishery goals into management actions. Goals include, among others:

- sustain or improve warmwater fish populations, as well as provide recreational opportunities to fish for these species;
- conduct walleye spawning population stock assessment in the Connecticut River;
- provide anglers with desired trout fishing experiences;
- protect, conserve, enhance, or restore anadromous and freshwater fish species of greatest conservation need;
- restoration of Atlantic salmon to the Connecticut River; and
- provide technical expertise on instream flow policies for the State of New Hampshire and to assist in developing policies for instream flow.

Fishery Management Plans

Atlantic salmon management in the Connecticut River basin is supported by state and federal legislation which created the Connecticut River Atlantic Salmon Commission (CRASC). The Connecticut River distinct population segment of Atlantic salmon was extirpated by the early 1800s with the loss of stocks indigenous to the Connecticut River (NMFS, 1999; Fay et al., 2006). Connecticut River restoration efforts have been conducted following the 1998 Strategic Plan for the Restoration of Atlantic Salmon to the Connecticut River (CRASC, 1998). CRASC developed a cooperative effort which includes habitat protection, fisheries management, research, regulation, hatchery production and stocking. The strategic plan seeks to accomplish the program mission to: “protect, conserve, restore and enhance the Atlantic salmon population in the Connecticut River basin for the public benefit, including recreational fishing”. However, during July 2012, FWS announced that it would no longer produce hatchery-reared stock for the effort to restore Atlantic salmon to the Connecticut River Basin due to the continued costs for low numbers of returns.

CRASC (1992) produced a management plan for American shad in the Connecticut River Basin with the overarching goal “to restore and maintain a spawning shad population to its historic range in the Connecticut River basin and to provide and maintain sport and the traditional in-river commercial fisheries for the species”. The primary management objectives included achieving and sustaining an adult population of 1.5 – 2 million entering the mouth of the Connecticut River annually, and achieving 40 percent – 60 percent passage at Holyoke dam, Massachusetts (the first barrier to upstream migration on the mainstem Connecticut River) and each successive upstream dam (Turners Falls, Vernon). In combination with a management objective of a maximum exploitation (fishing) rate of 40 percent, those objectives equate to an annual upstream passage objective of 144,000 to 432,000 American shad at Vernon dam, thus available to the Project affected area below the Bellows Falls dam. Other pertinent management objectives included:

- enhance and promote the recreational opportunities throughout the species' historical range;
- establish and maintain a permanent population monitoring program on the Connecticut River; and

- establish an annual research program to address management programs associated with shad restoration goals and objectives.

CRASC (2004) produced an amended management plan for river herring (blueback herring and alewife), in the Connecticut River Basin with the goal to "restore and maintain a spawning river herring population within its historic range in the Connecticut River basin". The primary management objective pertinent to the Project affected area below the dam included achieving and sustaining annual passage of 300,000 – 500,000 adults at Holyoke dam, Massachusetts, and passage of 40-60 percent of the spawning run at each successive dam (Turners Falls, Vernon). Those objectives equate to an annual passage of blueback herring at Vernon dam of 48,000 – 180,000. Other objectives pertinent to the Project included to "enhance, restore, and maintain river herring habitat in the Connecticut River basin."

The Atlantic States Marine Fisheries Commission (ASMFC) published its fishery management plans for American eel (ASMFC, 2000, 2006, 2008). The initial management plan presented primary objectives pertaining to an increased understanding of eel life history and population dynamics and sources of mortality through fishery dependent data collection, research and monitoring; protection and enhancement of eels in currently used habitats; and restoration to historically used habitats where practical. The 2008 addendum was published, in part, due to evidence that the American eels stock had declined and is at or near low levels. In it, ASMFC strongly recommended that member states and FWS request special consideration for American eel in the FERC relicensing process, including improving upstream and downstream passage, and collecting data on both (ASMFC, 2008).

ASMFC published its fishery management plan for American shad and river herring (blueback herring and alewife) in 1985 (ASMFC, 1985) in response to low commercial landings. Objectives of the plan included regulation of fishing mortality to ensure survival and enhancement of depressed stocks; improving habitat accessibility through improved or new fish passage facilities; improving water quality; ensuring that river flow allocation decisions consider flow needs of alosine fishes; ensuring that water withdrawal effects, including turbine mortalities, do not result in stock declines; initiate and expand stock restoration programs (larval and adult stocking); and support research programs relevant to development of management recommendations.

Amendment 2 to the plan (ASMFC, 2009), specific to river herring was published because stock assessments determined that many populations of river herring were in decline or depressed. The objectives of the amendment included preventing further declines in river herring abundance; improving the understanding of commercial fishery bycatch mortality; increasing understanding of fisheries, stock dynamics, and population health in order to evaluate management performance; retain existing or make more conservative regulations; and promote improvements in degraded critical habitat. Recommendations pursuant to habitat access that could be pertinent to the Project, assuming restoration of the migratory river herring population to the Connecticut River above Vernon dam included (paraphrased):

- Ensure that decisions on river flow allocation consider the flow needs of alosine fishes and minimize deviation from natural flow regimes.

- 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.
- When considering options for restoring alosine habitat, include study of, and possible adjustment to, dam-related altered river flows.

Amendment 3 to the ASMFC fishery management plan (ASMFC, 2010), specific to American shad, was published because a 2007 American shad stock assessment found that stocks were at all-time lows and did not appear to be recovering to acceptable levels. It identified the primary causes for continued declines as excessive total mortality, habitat loss and degradation, and migration and habitat access impediments. The objectives of amendment 3 included maximizing juvenile emigration from freshwater complexes; restoring and maintaining spawning stock biomass and age structure to achieve maximum juvenile recruitment; and manage harvest so that objectives 1 and 2 will not be compromised. A strategy to achieve those objectives included ensuring that adequate monitoring techniques are implemented to measure migratory success (i.e., upstream and downstream fish passage at barriers). The plan identified a number of issues specific to dams, some of which may be pertinent to the Project including (paraphrased):

- 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.
- Natural river discharge should be taken into account when instream flow alterations are being made to a river (flow regulation).
- Ensure that decisions on river flow allocation take into account American shad instream flow needs and minimize deviation from natural flow regimes.

3.6.4 Diadromous Species Descriptions

The life histories and distribution of diadromous fish species that are known or expected to inhabit Project waters are described below.

American Eel

The American eel is a catadromous fish species, spending the majority of its life cycle in freshwater and returning to the sea for the purposes of spawning. Various developmental stages of the species occur in freshwater, coastal waters and the open ocean as far north as Labrador and Greenland along the North American east coast to as far south as the Gulf of Mexico and northern South America (Facey and Van Den Avyle, 1987).

Following spawning in the Sargasso Sea (south of Bermuda, east of the Bahamas), the American eel larvae (leptocephali) are transported from spawning areas to the eastern seaboard by ocean currents (Facey and Van Den Avyle, 1987). While drifting, leptocephali undergo a metamorphosis during which changes to the depth and width of the body occur. During this period, the body thickness increases to a cylindrical form, larval teeth disappear, the aspect of the head and jaws changes and the digestive tract becomes functional (Smith and Tighe, 2002). American eels migrate towards freshwater from the ocean in the form of glass eels, the unpigmented post-larval form of the species. As they enter coastal areas, the body begins to pigment and the eels are then known as elvers (Facey and Van Den Avyle, 1987). The majority of glass eels and elvers reach the coastal rivers of New England during the spring (March-June). As elvers enter the growth phase they become known as yellow eels and will remain in that phase until they prepare to depart for spawning. When in freshwater, American eels tend to be bottom dwellers, increasing their activity levels at night (Scott and Crossman, 1973). They prefer to hide in burrows, plant masses or other natural substrate shelters (Facey and Van Den Avyle, 1987).

Sexual differentiation does not occur until eels are approximately 8-10 inches long. American eels may spend between 5 and 20 years in freshwater and sexual maturing takes place in the later summer or fall (Smith and Tighe, 2002). Upon initiation of maturity, eels stop feeding, develop a sharply bicolored body pattern (gray to black dorsal side and white ventral side), eyes and pectoral fins enlarge and the individual begins to move downstream. As yellow eels begin to sexually mature, they are known as silver eels. Emigrating silver eels primarily move at night and are also stimulated by pulses in flow associated with rain events. The minimum size of silver eels is approximately 11.5 inches (29 cm) for males and 18 inches (45 cm) for females. Female American eels grow much larger than males and average 24-39 inches (60-100 cm). American eels are among the most fecund fish species with egg production estimates reported to reach up to 10 million eggs.

American eel were documented upstream of Bellow Falls dam by New Hampshire Fish & Game (unpublished data) and Yoder et al. (2009), so it can reasonably be concluded that eels also reside downstream of the dam. Yoder et al. (2009) sampled only one downstream station and New Hampshire Fish & Game did not sample any stations downstream of Bellow Falls dam.

American Shad

American shad are an anadromous, highly migratory, coastal pelagic, schooling species that spend the majority of their life at sea (Stier and Crance, 1985; Munroe, 2002). American shad are found along the Atlantic coast from northern Labrador down to the St. John’s River, Florida. They are the largest member of the herring family (Clupeidae) and females are larger than males at all ages. Mature male shad range from 12 to 17.5 inches (30.5 - 44.7 cm) and mature females range from 15 to 19 inches (38.3 – 48.5 cm) (Stier and Crance, 1985).

American shad form large schools during their time at sea, ranging vertically from surface waters to a depth of 220 meters (722 feet) (Munroe, 2002). Adult shad return to coastal rivers to spawn during the spring when water temperatures are 16.5 – 19.0° C (61.7° F). In New England waters, males reach sexual maturity between ages 3 and 5 and females between ages 4 and 6. American shad are prolific spawners and large females can produce up to 600,000 eggs. Fecundity is highest in the southern portion of the species range and in older and larger females. Male American shad arrive at spawning areas ahead of females. Although shad spawn only in freshwater, there does not appear to be any required distance upstream of brackish water (Stier and Crance, 1985). Shad runs typically reach far upriver and often to the headwaters. Spawning occurs in river areas characterized by broad flats with relatively shallow water (1-6 m, 3.3 – 19.7 feet) and moderate current (0.3-1.0 m/s, 0.98 – 3.3 feet/s). Viable eggs have been recorded over bottom types ranging from fine sand to course rock and ledge but never over silt or mud bottom (Munroe, 2002). Northern populations of American shad exhibit high post-spawning survival and are considered iteroparous (repeat spawners). Fertilized shad eggs slowly sink to the bottom where they water-harden. Hatching takes place over a 6 to 15 day period (depending on water temperature) and the majority of larvae emerge during June. Larvae may remain in freshwater or drift into brackish water and grow rapidly; transforming into juveniles approximately 4 to 5 weeks after hatching (Stier and Crance, 1985). Juvenile shad form schools and gradually move downriver prior to departing for the ocean during late fall of the year that they were hatched.

American shad presence in the area below Bellows Falls dam is poorly documented, but known anecdotally through the recreational fishery, and from fish passage records. As a result of the Bellows Falls fish ladder, American shad are known to pass upstream of the dam; however, that may be artificial access to habitat that was not historically used.

Atlantic Salmon

Atlantic salmon is a highly migratory, anadromous fish species that was indigenous to suitable riverine habitat from northeastern Labrador south to the Housatonic River in Long Island Sound, New York (Kocik and Friedland, 2002). Numerous reviewers have detailed the life history of Atlantic salmon (Kocik and Friedland, 2002; Fay et al., 2006; NMFS, 2009). Adult Atlantic salmon begin to return to natal freshwater rivers during the spring and continue into October, often producing a spring and a fall run. The majority of fish returning to rivers in New England have been at sea for two years. A lesser component of the run consists of one or three sea-winter fish, and repeat spawners. Fecundity increases with age with a one sea-winter fish producing an average of 3,040 eggs, a two sea-winter fish producing an average of 7,560 eggs, a three sea-winter fish producing an average of 10,200 eggs and a repeat spawner producing an average of 11,350 eggs (Baum 1997). Nests, or redds are constructed by female salmon and eggs are deposited and immediately fertilized by male salmon during the late fall, generally in riffle habitat with coarse gravel substrate. Following the fall spawn, approximately 20 percent of spent adult salmon (called kelts) move downstream to the ocean, the remainder return to the ocean the following spring (Baum, 1997).

Eggs remain in the gravel until hatching during the early spring. Following a three to six week period, the young salmon emerge as fry and begin to actively seek food. As fry begin to feed, they develop cryptic vertical stripes and are then known as parr. Atlantic salmon in the Gulf of Maine typically remain in the parr stage for one to four years and remain resident to the freshwater river. Following that period, parr undergo a series of physiological and morphological changes known as smoltification; they lose their parr markings and develop a streamlined, silvery body and a pronounced forked tail. In this smolt stage, salmon migrate downstream to the ocean during spring (April-June). Out migrating smolts must adapt to changes in water temperature, pH, DO, salinity, pollution levels, predation and other factors as they move downstream.

Atlantic salmon fry and smolts have been stocked in tributaries throughout the Connecticut River Basin since 1968, with an annual stocking goal of 10 million fry per year. Since 2002, fry stocking has ranged from 6.0 – 7.8 million stocked annually to tributaries throughout the basin (USASAC, 2011). Atlantic salmon smolts migrating downstream from tributaries upstream of the Project must pass downstream of the Project. Between 2004 and 2011, 13,351 stream reared smolts collected at Moore dam were released below McIndoes dam (Normandeau 2005; 2006; 2007; 2008; 2009; 2010; 2011a). Hatchery reared smolts (1,921), utilized for radio telemetry, acoustic and PIT tag studies at Moore dam also were transported to and released below McIndoes dam. Early telemetry studies at Moore dam (1998 and 2000) yielded only ten passages during a spill event. Of those, three passed all dams between Moore and Turners Falls (Comerford, McIndoes, Dodge Falls, Wilder, Bellows Falls, and Vernon). Those three fish arrived at Turners Falls between six and eight days after passing Comerford Dam. A radio telemetry study conducted at McIndoes dam in 2003 included some manual tracking of tagged smolts after passing the dam. Five of 220 released for the study were located in reaches of the Connecticut River between Wilder dam and Bellows Falls dam before tracking was suspended 20 to 30 days after the final smolt passed McIndoes dam.

During July 2012, FWS announced that it would no longer produce hatchery-reared stock for the effort to restore Atlantic salmon to the Connecticut River basin due to the continued costs for low numbers of returns. No further status of the program or state management changes are available at this time.

Adult Atlantic salmon have been documented in the Project affected area. Since 1998, a percentage of adult salmon returning to the Connecticut River have been radio-tagged at the Holyoke fishlift to monitor their movements within the Connecticut River basin. Of 146 individuals radio-tagged from 1998 to 2011, 31 (21 percent) used the Project fish ladder. Fifty-percent of all tagged salmon that passed Vernon dam also passed Bellows Falls dam (31 of 62; Normandeau, 2011b). In general, upstream migrating adult salmon arrive at the Project in spring and summer and down-migrating kelts arrive from upstream in the fall.

Blueback Herring

Blueback herring are a schooling, anadromous clupeid species found along the Atlantic coast from Nova Scotia down to the St. John’s River, Florida (Pardue, 1983, Munro, 2002). Although adult blueback herring have been reported up to 15 inches (38 cm) in length, few individuals attain a length greater than 12 inches (30 cm; Munroe, 2002). Females are longer than males (Munroe, 2002).

Blueback herring return to coastal rivers to spawn from March through July, with individuals in the northern part of the range spawning later in the year (Pardue, 1983). The majority of blueback herring are fully recruited to the spawning population by age 5 with most first time spawners being age 4 (Munroe, 2002). Fecundity among individuals varies (30,000 – 400,000 eggs) with highest levels observed in older and larger females. Male blueback herring arrive at spawning streams earlier than females and spawning generally begins at water temperatures of 10-15° C. Spawning occurs in fresh or brackish water above the head of tide and typically takes place over areas of hard substrate where flow is rather swift. Spent adult fish return to the ocean shortly after spawning. Spawned eggs are pelagic or semidemersal, becoming less adhesive as they progress through the water-hardening stage (Pardue, 1983; Munroe, 2002). Following hatching (3-4 days at 20-21° C) the yolk-sac larvae have limited swimming ability and are carried by river flows downstream to slower moving water where they grow and develop into juveniles (Munroe, 2002). Juvenile blueback herring typically emigrate from nursery areas between June and November (Pardue, 1983).

The Connecticut River blueback herring population has declined to the point where none have been recorded passing Vernon dam since 2000, so there are presently no blueback herring using habitats in the Project affected area to the historic limit of upstream migration at Bellows Falls. However, access to those habitats is provided by fish passage at all mainstem dams.

Sea Lamprey

Sea lamprey are an elongate, eel-like anadromous species found along the Atlantic coast from Labrador to Florida (Smith, 1985; Flescher and Martini, 2002). Adult sea lamprey reach an average length of 28 inches (72 cm) at the start of spawning with a maximum recorded length of 35 inches (90 cm; Flescher and Martini, 2002). Sexually mature adults can be characterized by strong sexual dimorphism with male lamprey developing a pronounced ventral ridge and female lamprey developing a prominent ventral ridge.

While at sea, adult sea lamprey parasitize a range of fish species by attaching to them with 11-12 rows of horny, hooked teeth located in an oral hood. Sea lampreys typically attach to the side of their prey and rasp at the flesh until they can feed on blood. Adult sea lampreys return to coastal streams during the spring, peaking during May and June in Gulf of Maine rivers. Sea lampreys seek out river or stream reaches that contain gravel substrate and swift current velocities, and eggs are deposited in a shallow nest depression constructed on the bottom. The majority of spawning adults are eight years of age (Beamish and Medland, 1988) and an average female contains 200,000 eggs. Deposited eggs develop over a 10-13 day period after which the larvae (called an ammocoete) develops gill clefts, an oral hood and body pigmentation (Flescher and Martini, 2002). Ammocoetes travel downstream to low velocity areas with muddy or sand bottom where they construct a shallow burrow. Ammocoetes are filter feeders and diatoms comprise the majority of their diet. The larval period generally lasts for five years (Beamish and Medland, 1988) after which the ammocoetes transform into juveniles over a 4 to 6 month period. During the transformation, eyes and related musculature, oral hood and teeth, salivary glands, new kidneys and pigmentation develop (Flescher and Martini, 2002). Juvenile lamprey move away from the river bottom and downstream where they are capable of entering seawater and adopting a parasitic life style.

Sea lamprey were documented in the Project affected area upstream and downstream of Bellows Falls dam (New Hampshire Fish & Game, unpublished data; Yoder et al., 2009). A total of 33 individuals were collected during the 2008 electrofishing survey which sampled approximately 7 river km (4.3 RM) of habitat in the impoundment and 1 river km (0.6 RM) downstream of the dam. Abundance relative to total catch at the four sites where sea lamprey were present in the impoundment ranged from 0.59 to 1.49 percent. At the single station sampled below the dam, 5 individuals were collected representing 2.28 percent of the total catch.

3.6.5 Resident Species Descriptions

The life histories and distribution of selected game species and resident species of greatest conservation need (Kart et al., 2005; New Hampshire Fish & Game, 2007) documented or that may reside in the Project affected area are described below.

Bridle Shiner

Bridle shiner is a small freshwater minnow species occurring in the Atlantic drainage of the eastern United States from southern Maine to Virginia and west to New York (Scott and Crossman, 1979). Bridle shiner prefer clear water in the low current sections of streams and rivers. They often associate with moderate levels of submerged aquatic vegetation and bottom substrates of silt and/or sand. Spawning takes place from late-May through July in water depths of 2 to 3 feet and areas surrounded by dense vegetation. Bridle shiner was listed as threatened by the state of New Hampshire in 2008.

Yoder et al. (2009) did not collect bridle shiner in the Project affected area and New Hampshire Fish & Game did not describe the Connecticut River as bridle shiner habitat, however four individuals were identified from a single collection in the Wilder Project affected area upstream, so could exist in the Bellows Falls impoundment as well.

Brook Trout

Brook trout is native to the Atlantic seaboard south to Cape Cod, in the Appalachian Mountains southward to Georgia, west in the upper Mississippi and Great Lakes drainages to Minnesota, north to Hudson Bay (Scott and Crossman, 1979). Since the late 19th century, brook trout have been introduced into 20 additional states (Raleigh, 1982). Brook trout prefer clear, cool, well oxygenated water in streams and lakes. They tend to seek water temperatures below 68° F.

Brook trout spawn during the fall (September – November) in gravel beds located in the shallows of stream headwaters (Scott and Crossman, 1979). Mature fish (generally age 3) may migrate significant distances to reach appropriate spawning habitat with males arriving on site prior to females. Spawning takes place over a nesting area which is excavated by the female. The eggs are relatively large and fecundity estimates vary by body size with a reported range of 100 to 5,000 eggs. Eggs overwinter in the gravel substrate and hatching times range from 50 to 100 days, depending on water temperatures. Upon hatching, brook trout larvae remain in the gravel. They become free swimming at a body length of approximately 1.5 inches.

Brook trout were not documented in the Project affected area during the most recent fisheries survey (Yoder et al. 2009). However, the States of New Hampshire and Vermont both stock brook trout into tributaries that enter the Project. Trout stocked in those tributaries may move to the mainstem river and are known to be taken in the fishery at the Project (http://www.wildlife.state.nh.us/Fishing/fisheries_management/walleye_survey.html).

Rainbow Trout

The original range of rainbow trout included freshwater habitats and coastal areas of the eastern Pacific Ocean extending from northwestern Mexico up to the southwestern coast of Alaska. Their popularity as a sport and food fish, as well as the variety of strains available resulted in human introductions that have greatly expanded their distribution. Rainbow trout, first introduced into New England waters during the late 1800's (New Hampshire in 1878 and Vermont in 1886) are now found in cold water streams and lakes across both states, including the Connecticut River and its tributaries (Scarola, 1987; Langdon et al., 2006).

Rainbow trout are spring spawners with most strains spawning from mid-April to the later part of June. Rainbow trout spawn almost exclusively in streams, and successful reproduction has been documented within intermittent tributaries and lake outlets. River-resident rainbow trout generally spawn in headwater areas of the mainstem or smaller tributaries. Mature rainbow trout (2-3 years of age or older) may start to ascend spawning tributaries as early as late fall in search of suitable spawning habitat, and spawning behavior generally occurs at water temperatures between 50-60° F. Females locate areas for redd excavation, which typically consist of riffles located above larger sized holding pools or tail-outs below pools where water depth, flows, and gravel sizes are appropriate. Females often spawn in several different redds with one or more males. After spawning the female moves upstream of the redd and covers it with gravel. Like most fish species, water temperatures heavily influence the incubation period, but eggs generally hatch in 4-7 weeks. Sac-fry remain in the gravel for up to a week while they absorb their egg sacs, and free-swimming fry begin to feed within two weeks of hatching. Fry of river resident rainbow trout remain in the stream system.

Juvenile and adult rainbow trout are opportunistic feeders that consume a wide variety of food. Aquatic insects are the most common item consumed, but zooplankton, terrestrial insects, crustaceans, mollusks, amphibians, leeches, and fish can be seasonally or locally important. Rainbow trout, like other salmonids, generally shift their diet from smaller sized food items (i.e., plankton) to larger items as they grow in size. Fish generally do not become an important part of the diet until adult rainbow trout reach approximately 12 inches long.

Rainbow trout were not documented in the Project affected area by Yoder et al. (2009); however, the States of New Hampshire and Vermont both stock rainbow trout into tributaries that enter the Project. Trout stocked in those tributaries are known to be taken in the fishery at the Project (http://www.wildlife.state.nh.us/Fishing/fisheries_management/walleye_survey.html).

Redbreast Sunfish

Redbreast sunfish inhabit the shores of lakes and ponds, and pools of clear streams with little current, but are more stream adapted than other sunfishes found in the

Connecticut River Basin. Redbreast sunfish can be found over gravelly bottoms with or without vegetation (Scarola, 1973). Suitable water temperatures for growth and survival of adult and juvenile fish are assumed to be 15 - 35°C, and for spawning and incubation the optimal range is assumed to be 21 - 27°C. Spawning nests are generally constructed at depths less than 1.5 m, and a mixture of coarse sand and gravel appears to be required for successful spawning. Water velocities at nest sites are less than 0.06 m/s with an average of 0.02 m/s.

The redbreast sunfish occurs along the Atlantic Slope from New Brunswick to Florida, as well as Gulf Coast drainages. In Vermont, redbreast sunfish are found in the Connecticut River and lakes Morey and Fairlee (Orange County) and the Black River (Windsor County). However, its spotty distribution and relatively infrequent observation, even within the waters where it is known to occur, led to the species listing by Vermont as a species of greatest conservation need. The species is known to occur in the Project affected area (Kart et al., 2005).

Yoder et al. (2009) collected two redbreast sunfish, one at each of two (of six total) stations sampled in the Project affected area. Both were collected in 1 km electrofishing samples at stations in the impoundment. Relative abundance was 1 fish/km at both stations and the numeric proportion of the catch was 0.3 and 1.4 percent.

Slimy Sculpin

Slimy sculpin is found in all major watersheds in New Hampshire except the coastal watersheds in cool streams and cold deep lakes with rock and gravel substrates. The species is commonly found under rocks in both rivers and lakes. Populations are more common in central and northern New Hampshire, often sharing stream habitat with eastern brook trout (Scarola, 1987). Slimy sculpin spawn in spring in water temperatures from 40 to 50° F (Scott and Crossman, 1973).

Slimy sculpin was listed as a species of greatest conservation need in New Hampshire because it is one of three New Hampshire fish species, along with tessellated darter and Atlantic salmon, that serve as hosts to the federally and state endangered dwarf wedgemussel (Nedeau et al., 2000). Healthy populations of slimy sculpin in the Connecticut and Ashuelot rivers likely contribute to the persistence of dwarf wedgemussel populations in New Hampshire. Yoder et al. (2009) did not collect slimy sculpin in the Project affected area.

Smallmouth Bass

Smallmouth bass are not native to the Connecticut River, and were introduced into New Hampshire waters some time during the 1860s (Scarola, 1987). The native range for this species was limited to the Great Lakes-St. Lawrence system and the Ohio, Tennessee, and upper Mississippi river systems. This species now occurs almost everywhere in the U.S. (Scott and Crossman, 1979). Smallmouth bass inhabit cool and warm, generally clear, large creeks, streams, and rivers with gravelly and rocky substrates. Often they become a dominant species in reservoirs that impound streams with the above attributes (Jenkins and Burkhead, 1993). Usually they are found around the protection afforded by the rocks of shoals and talus slopes, or submerged vegetation in moderately shallow water (Scott and Crossman, 1979).

Smallmouth bass were collected in all stations sampled by Yoder et al. (2009). Abundance ranged from 1 to 98 fish per km sampled for stations in the Project affected area upstream of the dam with the lowest abundance in the Bellows Falls impoundment. In the only station sampled in the Project affected area downstream of Bellows Falls dam, smallmouth bass abundance was 77 fish per km. The smallmouth bass proportion of catch ranged from 0.9 – 38.3 percent over all stations.

New Hampshire Fish & Game has collected smallmouth bass relative abundance, age, and growth data for selected stations in the Project affected area upstream of Bellows Falls dam (table 3.6-4, New Hampshire Fish & Game, unpublished data). With regard to relative abundance, their results, 100 fish per km, were similar to the high observations made by Yoder et al. (2009). Length and weight data for a sample of 15 smallmouth bass sampled from reach 5 (above Vernon dam to Wilder dam, collection sites were not specific) were collected for determination of condition factor (see figure 3.6-6) for the Connecticut River fish tissue contamination study (Hellyer, 2006). Scales and otoliths from those samples were also processed for age analysis (Smithwood, 2004). Smallmouth bass ages ranged from 2 – 6 years (table 3.6-5). Gries (2011) reported on black bass (largemouth and smallmouth bass) young-of-year surveys conducted in New Hampshire waters, including the Connecticut River. The objectives included determination of fish size and relative abundance, an examination of relative abundance among years, and a comparison of size among years. Sampling was conducted during 1996-1999, 2002, and 2004-2010 in two reaches of the Connecticut River in the Project affected area upstream

Table 3.6-4. Summary results of six electrofishing survey sampling runs in the Connecticut River in the Project affected area upstream of Bellows Falls dam (Charlestown and Claremont reaches) Fall, 2002 (Source: New Hampshire Fish & Game, unpublished data).

Species	Number caught	Catch (fish/hr)	SD	Length (mm)	Number Measured	SD	Weight (g)	Number Weighed	SD
Bluegill	3	7.1	12.4	33.33	3	1.53	-	0	-
Largemouth Bass	15	4.9	6.6	157.73	15	101.97	162.93	15	326.78
Northern Pike	2	2.7	3.4	472.50	2	243.95	930.50	2	1088.24
Rock Bass	69	164.3	44.6	59.65	69	30.88	258.00	1	-
Smallmouth bass	331	100.0	115.7	135.49	331	89.45	106.42	330	277.10
Tessellated Darter	5	11.9	10.9	69.00	5	9.19	-	0	-
Walleye	6	1.9	3.1	405.33	6	44.11	600.17	6	206.93
Yellow perch	5	11.9	10.9	151.00	5	10.51	39.60	5	6.43

Table 3.6-5. Age analysis of smallmouth bass sampled in Reach 5 (above Vernon dam to Wilder dam) by Hellyer et al. (2006) (Source: Smithwood, 2004).

Field Sample Number	Whole Body Weight (gm)	Total Length (cm)	Age Determination from Scales			Age Determination from Otoliths			Reconciled Age Determination
			# of annuli	age	comments	# of annuli	age	comments	
CT5-SMB-01	798.2	37.6	5	5		5	5		5
CT5-SMB-02	792.4	36.6	5	5		5	5		5
CT5-SMB-03	571.3	34.1	4	4	1	3	3	17	4
CT5-SMB-04	717.9	36.0	4	4	7	4	4		4
CT5-SMB-05	494.2	31.2	3	3		3	3	15	3
CT5-SMB-06	432.2	30.8	3	3		3	3		3
CT5-SMB-07	683.1	35.5	4	4	6	4	4	6	4
CT5-SMB-08	514.4	32.0	3	3	12	3	3		3
CT5-SMB-09	308.9	28.0	3	3		NA	NA		3
CT5-SMB-10	1020.9	39.2	6	6		6	6	18	6
CT5-SMB-11	657.3	35.7	5	5	8	5	5		5
CT5-SMB-12	378.4	28.4	3	3		3	3	4	3
CT5-SMB-13	782.0	37.3	6	6		5	5		5
CT5-SMB-14	395.7	29.4	3	3	4,7	3	3	16	3
CT5-SMB-15	240.6	24.5	2	2	7,12	NA	NA		2

Note: Summary Reach 5: Most of the scale samples in Reach 5 had annuli near their margin. Therefore the age determination from scale for specimen in the Reach is given as the same as the number of annuli.

of Bellows Falls dam, Little Sugar River to Black River (Charlestown reach) and Sugar River to Ashley Ferry, Clairmont, New Hampshire (Clairmont reach). Gries (2011) found that smallmouth bass length and weight differed significantly among years, and that there was an interactive effect with largemouth bass for length and weight. Additionally, he reported that the mean length and relative abundance of smallmouth bass was higher in the Connecticut River samples as compared to several other water bodies in New Hampshire.

Tessellated Darter

Tessellated darter reside year round in freshwater and is one of over 100 species of darter in the genus Etheostoma (Smith, 1985). Tessellated darters range from the St. Lawrence drainage in southern Quebec, the southern tributaries of Lake Ontario, the Connecticut River and coastal Massachusetts to the Altamaha River in Georgia. Tessellated darters have a slender, elongate body and an average total length of 2.3 inches (5.8 cm; Scott and Crossman, 1979). Although male tessellated darters grow to a larger size than females, female of the species live longer. Female tessellated darters have been aged as old as four years whereas male individuals have not been aged older than three years. This species is characterized by a distinctive series of dark X- or W-shaped marks along the midline of the body.

Although tessellated darters prefer areas with moderate to no current, they can be found in areas with swifter current (Scott and Crossman, 1979). Outside of the breeding season, tessellated darters show a preference for sandy or mud bottoms. Spawning occurs during the spring and exact timing likely varies with latitude. Male tessellated darters move into rocky spawning habitat in advance of females. They establish and defend a territory and clear off the underside of a rock for use as a spawning site. Upon arrival of a female, spawning takes place and five or six clutches of 30-200 eggs are deposited and fertilized. Following spawning, females depart the area and the male darter remains to guard the eggs. Eggs hatch over a period of five to eight days (depending on water temperatures).

Tessellated darter play an important role in the life cycle of the dwarf wedgemussel, a federally endangered freshwater mussel species inhabiting small streams to large rivers with moderate flow within the Atlantic drainage (Wicklow, 2005). The species is generally found in hydrologically stable areas and preferred habitat is comprised of gravel, coarse sand, find sand and clay. Similar to other freshwater mussel species, the reproductive cycle for the dwarf wedgemussel requires a host fish onto which the glochidia (larvae) can parasitize and metamorphose into juveniles. Dwarf wedgemussel glochidia have hooked valves which they use to attach to fins, lips and other soft, scaleless tissue of their host (Michaelson and Neves, 1995), typically during April to mid-June (Wicklow, 2005). Tessellated darter is one of three New Hampshire fish species, along with slimy sculpin and Atlantic salmon, that have been identified as host species (Nedeau et al., 2000).

Yoder et al. (2009) documented tessellated darters in the Project affected area upstream and downstream of the dam. Tessellated darters were recorded at 5 of 7 sample areas upstream of the dam. Abundance at those five areas ranged from 12 to 24 fish per km. At the one site sampled in the Project affected area downstream of the dam tessellated darter abundance was 6 fish per km. Tessellated darter comprised from1.83 to 10.45 percent of total catch by number at the stations where the species was collected.

Walleye

Walleye are native to freshwater rivers and lakes of Canada and the United States, primarily east of the Rocky Mountains and west of the Appalachians. As a highly prized sport fish, walleye have been widely introduced into rivers and reservoirs, including the Connecticut River. Walleye tolerate a wide range of environmental conditions, necessary for widespread introductions, but are reported to be most abundant in medium to large (> 100 hectares) lentic and lotic systems with generally mesotrophic conditions. Such systems also share cool temperatures (or at least provide access to them, e.g., cool tributaries, deeper portions of reservoirs), shallow to moderate depths, extensive littoral areas, moderate turbidities, and access to areas of clean, rocky substrate (McMahon et al., 1984).

Yoder et al. (2009) documented walleye in the Project impoundment but not downstream of the dam (where only 1 station was sampled); however, walleye are well documented downstream in the New Hampshire Fish & Game creel surveys, (http://www.wildlife.state.nh.us/Fishing/fisheries_management/walleye_survey.html). New Hampshire Fish & Game has collected walleye relative abundance, age, and growth data for selected stations in the Project area upstream of Bellows Falls dam (see table 3.6-4, New Hampshire Fish & Game, unpublished data).

3.6.6 Aquatic Habitat

In conjunction with the assessment of the fish assemblage in the mainstem Connecticut River, a qualitative evaluation of macrohabitat was made for each location sampled (Yoder et al., 2009). The Qualitative Habitat Evaluation Index (QHEI; Rankin, 1989, 1995; Ohio EPA, 2006), a physical habitat index designed to provide an empirical, qualitative evaluation of the lotic macrohabitat characteristics that are important to fish assemblages, was used. The QHEI consists of a visual estimate of the quality, composition, amount, and extent of substrate, cover, channel, riparian, flow, pool/run/riffle, and gradient variables, and has been shown to correspond predictably with key attributes of fish assemblage quality (Rankin, 1989, 1995).

Their results depicted fewer 'good' attributes and more 'modified' attributes in the Project affected area as compared to sites far up river (e.g., more than 46 miles upstream of Wilder dam). The distribution of both 'good' and 'modified' attributes in the Project affected area was similar to river reaches upstream and downstream of it. Habitat attributes affecting the QHEI in the Project affected area were typical of impoundments/hydroelectric developments, including reduced substrate diversity, siltation/substrate embeddedness, lack of current complexity, and lack of riffle/run characteristics, and modified flows (figure 3.6-8).

Key QHEI Components

			Good Attributes											Modified Attributes														
River Mile	QHEI	Gradient (ft/mile)	No Channelization/Recovered	Boulder, Cobble, Gravel Substrates	Silt Free Substrates	Good/Excellent Development	Five or More Substrate Types	Extensive-Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 1 m	Low-Normal Riffle/Run Embeddedness	Good Habitat Attributes	Impounded	Channelized or No Recovery	Silt/Muck Substrates	Sparse or No Cover	Max Depth < 70 cm	Recovering Channel	High/Moderate Silt Cover	Fair-Poor Development	Only 1-2 Cover Types	Slow or No Flow	High-Mod Overall Embeddedness	High-Mod Riffle-Run Embeddedness	No Riffle/Run	Total Modified Attributes	Modified: Good Ratio
(80-001)																												
Year:	2008																											
200.7	50.0	2.50		■			■	■			■		4	◆			◆				■		■	■		■	6	1.50
194.4	50.8	2.50						■			■		2	◆							■		■	■		■	5	2.50
179.2	53.0	2.50		■			■	■			■		3	◆						■	■		■	■		■	6	1.50
170.9	53.0	2.50		■			■	■			■		3	◆						■	■		■	■		■	6	1.50
166.3	63.0	2.50		■			■	■			■		4	◆						■	■		■	■		■	6	1.50
165.6	46.0	0.10				■		■			■		3	◆	◆					■			■	■		■	6	2.00
163.9	67.0	2.50	■	■		■			■	■	■		7				◆					■			■		3	0.50
161.5	71.5	2.50	■	■		■	■	■			■		6		◆										■		2	0.33
155.6	51.0	2.00						■			■		2	◆	◆					■	■			■	■		6	3.00
153.8	62.8	2.00		■	■				■		■	■	6				◆		■		■	■		■			5	1.00
148.5	68.0	2.00		■				■	■		■		4						■	■	■			■	■		5	1.25
144.4	63.5	2.00	■	■				■			■		4							■	■		■	■	■		5	1.25
139.5	68.0	2.00	■			■	■	■			■	■	5		◆					■			■	■			4	0.67
137.4	68.0	2.00	■	■				■			■		4							■	■		■	■	■		5	1.25
133.2	49.0	2.00	■					■			■		3		◆					■	■		■	■			5	1.67
131.4	51.0	2.00	■								■		3		◆					■	■		■	■			5	2.50
125.6	48.5	0.10	■			■		■			■		4	◆	◆					■			■	■		■	6	1.50
121.9	49.0	2.50					■	■			■		2	◆	◆					■	■		■	■		■	7	2.33
116.2	79.0	2.00		■			■	■			■	■	4						■		■			■			3	0.60
114.7	63.0	2.00	■					■		■	■		4							■	■		■			■	4	1.00
105.7	70.0	2.00	■			■		■		■	■		5										■			■	2	0.40
102.3	59.5	2.00	■					■		■	■		4		◆					■			■			■	4	1.00
97.6	54.0	2.00	■			■					■		4		◆		◆			■			■	■		■	6	2.00
92.5	55.0	2.50					■	■			■		2	◆	◆					■	■		■	■		■	7	2.33
90.1	48.0	2.50						■			■		2	◆	◆					■	■		■	■		■	7	3.50
89.0	52.0	2.50						■	■		■		3	◆	◆					■	■			■		■	6	2.00
88.4	95.5	2.50	■	■		■	■	■	■	■	■	■	9														0	0.00
83.3	62.5	2.50	■	■			■	■		■	■		5								■					■	2	0.33
79.2	64.3	2.50	■	■				■		■	■		5								■		■			■	3	0.60
72.2	74.0	2.50	■	■			■	■	■	■	■		7				◆				■					■	3	0.43
68.8	54.5	2.50						■			■		2	◆							■		■	■		■	5	2.50

Project affected area

Upstream (impoundment): River Miles 144.4–121.9

Downstream: River Mile 116.2

Source (Yoder et al. 2009)

Figure 3.6-8. Qualitative Habitat Evaluation Index report for sites sampled in the Connecticut River during 2008 (Source: excerpted from Yoder et al., 2009).

Essential Fish Habitat

Pursuant to the Magnuson-Stevens Fishery Conservation and Management Act, amended in 1996 (Public Law 94-265), habitats essential to federally managed commercial fish species are to be identified and measures taken to conserve and enhance that habitat. Essential fish habitat was defined as "all waters currently or historically accessible to Atlantic salmon within the streams, rivers, lakes, ponds, wetlands, and other water bodies of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut" (New England Fisheries Management Council, 1998).

3.6.7 Mussels and Macroinvertebrates

The following resources and studies were reviewed to describe freshwater mussel and macroinvertebrate resources in the Project affected area:

- New Hampshire and Vermont Wildlife Action Plans, 2005
- FWS Northeast Region surveys and reports
- A freshwater mussel survey in the Connecticut River for the Vernon, Bellows Falls, and Wilder Hydroelectric Projects contracted by TransCanada
- Surveys and reports sponsored by the Vermont Fish and Wildlife Department
- Surveys and reports sponsored by the New Hampshire Fish and Game Department
- EPA National Rivers and Streams Assessment http://water.epa.gov/type/rsl/monitoring/riverssurvey/index.cfm
- New Hampshire DES Biological Monitoring Program

Mussels

The Connecticut River watershed in New Hampshire and Vermont supports nine species of freshwater mussels, seven are found within the mainstem of the Connecticut River and near the mouth of mainstem tributaries, including the federally endangered dwarf wedgemussel. All seven of these freshwater mussel species have been identified in the Project affected area. A mussel survey of the Project affected area, with emphasis on dwarf wedgemussel, was commissioned by TransCanada and carried out in 2011 by Biodrawversity and LBG (draft 2012). The survey was developed in response to state and Federal wildlife agency staff identification of this resource data gap during a pre-relicensing meeting. Biodrawversity and LBG surveyed the tailwater below the Bellows Falls dam (less than 1 mile below the dam) and 45 sites in the Bellows Falls impoundment and near the mouth of the Williams River, Black River and Sugar River, for freshwater mussels with a focus on dwarf wedgemussel.

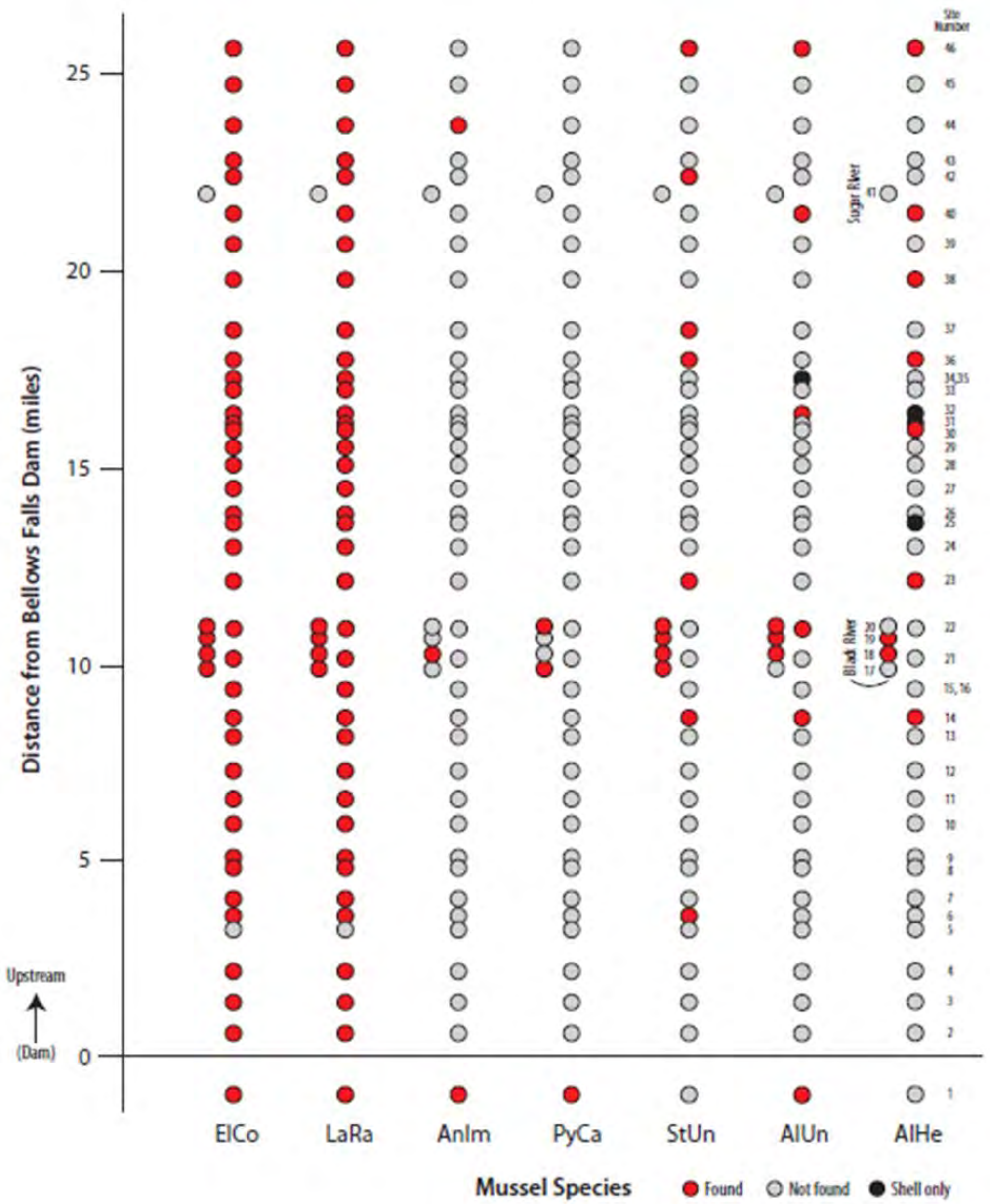

Figure 3.6-9. Survey sites where mussel species were found in the Project affected area. Species abbreviations are: ElCo = eastern elliptio, LaRa = eastern lampmussel, AnIm = alewife floater, PyCa = eastern floater, StUn = creeper, AlUn = triangle floater, AlHe = dwarf wedgemussel (Source: Biodrawversity and LBG, draft 2012).

Mussels were found at all but two sites, the mouth of the Williams River and the mouth of the Sugar River (Biodrawversity and LBG, draft 2012; figure 3.6-9). Five species were found in the tailwater, they were: eastern elliptio (*Elliptio complanata*), eastern lampmussel (*Lampsilis radiata*), alewife floater (*Anodonta implicata*), eastern floater (*Pyganodon cataracta*), and triangle floater (*Alasmidonta undulata*). Seven species were found in the impoundment, they included the five species found in the tailwater plus dwarf wedgemussel and creeper (*Strophitus undulatus*). Species richness, i.e., the number of species found at each site, was generally greater in the upper half of the impoundment from just below the confluence of the Black River. Eastern elliptio and eastern lampmussel were the most abundant species found, averaging about 265 eastern elliptio per site and 40 eastern lampmussel per site below the dam and 180 eastern elliptio per site and 65 eastern lampmussel per site above the dam.

Dwarf wedgemussel was the least abundant species encountered; 11 were found in 9 sites over a 17-mile distance, 4 of these were found in the mouth of the Black River (Biodrawversity and LBG, draft 2012). In 2001, O'Brien (2002) surveyed mussels in two locations in the upper half of the Bellows Falls impoundment near Cornish, Vermont. Similar to Biodrawversity and LBG (draft 2012) she found eastern elliptio was the most abundant species followed by eastern lampmussel; however, dwarf wedgemussel (n=55) were found more frequently than triangle floater (n=12), or creeper (n=1). Fichtel and Smith (1995) and Biodrawversity and LBG (draft 2012) both reported sites within the Bellows Falls impoundment that supported dwarf wedgemussel also supported triangle floaters.

In the mouth of the Black River, Ferguson (1999), who assessed dwarf wedgemussel distribution and habitat in large tributaries of the Connecticut River, found dwarf wedgemussel, along with four of the species found by Biodrawversity and LBG (draft 2012; eastern elliptio, eastern lampmussel, triangle floater, and creeper). Ferguson (1999) did not find any mussels in the mouth of the Ottauquechee or Williams Rivers.

In their WAP, Vermont Fish & Wildlife classify alewife floater as a species of greatest conservation need, with a rating of rare (S2). This species inhabits streams, rivers, and lakes. However, the highest densities are found in coastal ponds with a direct unimpeded connection to rivers that support yearly runs of alewife. Its habitat use and population density seems to be more strongly tied to where its host fish are likely to spawn or congregate (Nedeau, 2008a). Biodrawversity and LBG (draft 2012) found only 2 (catch per unit effort [CPUE]=0.05 mussels per hour) alewife floater in the Bellows Falls impoundment but as many as 217 (CPUE = 27.75 mussels per hour) in the tailwater.

Alewife floater

Alewife floater occurs along the Atlantic Slope from South Carolina to Nova Scotia and is somewhat common in coastal waterbodies (Strayer 1997; Biodrawversity and LBG, draft 2012). It is typically found in streams, rivers, and lakes, in a variety of habitats including small cobble, gravel, sand, silt, and clay. In the Connecticut River alewife floater were found at depths between 3-20 feet. The alewife floater is a long term brooder, eggs are fertilized in late summer and glochidia are released the following spring. Host fish species include alewife (*Alosa pseudoharengus*), American shad and blueback herring.

Dwarf wedgemussel

The dwarf wedgemussel lives along the Atlantic slope from North Caroling to New Brunswick (Moser, 1993). Populations have declined precipitously over the last hundred years. Once known in at least 70 locations in 15 major Atlantic slope drainages it is now known in only 20 localities in eight drainages. These localities are in New Hampshire, Vermont, Connecticut, New York, Maryland, Virginia, and North Carolina (Moser, 1993). Two of the most robust populations are found in New Hampshire rivers, the Connecticut River and the Ashuelot River (Strayer et al., 1996).

Dwarf wedgemussel is a long-term brooder. Fertilization occurs in the summer or early fall and glochidia are released during the following spring. Spawning occurs in summer when sperm are released into the water column and drawn into the inhalant aperture of the female. Eggs are fertilized, undergo development, and mature in the outermost demibranchs of each gill. Well-developed glochidia are present in the Connecticut River mussels as early as late August. The glochidia are held through the winter until release begins in early March and continues through mid-June. Glochidia must attach to a host fish in order to complete development and to facilitate dispersal. Host fish include the tessellated darter, johnny darter (*Etheostoma nigrum*), mottled sculpin (*Cottus cognatus*), slimy sculpin, and Atlantic salmon.

Dwarf wedgemussels habitat includes flowing water in small streams to large rivers with slow to moderate currents. Substrate preferences include gravel, sand, cobble with interstitial gravel and sand, mud/sand, and clay. They are not found in soft, silty mud, but may be buried in sand with an overlying layer of silt.

The dwarf wedge mussel was federally listed as an endangered species in March, 1990. It is also listed as endangered in the states of Vermont and New Hampshire. To meet recovery objectives to (1) downlist the species to threatened status, and (2) delist, the FWS has identified the following actions needed:

1. Collect basic data needed for protection of dwarf wedgemussel populations.
2. Preserve dwarf wedgemussel populations and occupied habitats.
3. Develop an education program.
4. Conduct life history studies and identify ecological requirements of the species.
5. If feasible, re-establish populations within the species' historical range.
6. Implement a program to monitor population levels and habitat conditions.
7. Periodically evaluate the recovery program.

A dwarf wedgemussel recovery plan was written to protect and enhance habitat of current dwarf wedgemussel populations and establish or expand populations within rivers or river corridors historically containing the species (Moser, 1993). The most recent 5-year review was published in 2007 and retained the species' status as federally listed as endangered (FWS, 2007). On June 8, 2011, a notice of initiation of review and request for information was published in the Federal Register, initiating the FWS' 5-year status reviews for dwarf wedgemussel under the ESA.

Limited benthic macroinvertebrate data are available for the Project. In 2008 and 2009 the EPA collected baseline data in the Project affected area for a National Rivers and Streams Assessment (NRSA), a study of the conditions of the Nation's flowing waters that will combine an assessment of the nation's rivers with a national survey of small wadeable streams (EPA, 2012). While a final report is not due out until the end of 2012, a summary of benthic macroinvertebrate overall abundance is available (table 3.6-6). NRSA sampling was conducted at two locations in the Bellows Falls impoundment: Claremont, New Hampshire, 17 miles upstream of Bellows Falls dam, and Cornish, New Hampshire, 24 miles upstream of the dam (D. Neils, New Hampshire DES Biological Monitoring Program Manager, personal communication).

Table 3.6-6. Summary metrics from benthic samples in the Project affected area collected by EPA for the National Rivers and Streams Assessment.

Station Id	Town	Sample Date	Sample Type	Metric	Value
FW08NH011	Claremont	7/16/2008	PRIMARY	taxa richness	29
				total abundance	260
				EPT richness	7
				% dominant taxon	61
FW08NH017	Cornish	7/14/2008	PRIMARY	taxa richness	67
				total abundance	520
				EPT richness	27
				% dominant taxon	18

Data summarized for these collections includes taxa richness (or abundance), total abundance of macroinvertebrates, EPT richness (i.e., total number of mayfly (Ephemeroptera), stonefly (Plecoptera), and caddisfly (Trichoptera) orders in the sample), and the percent of the sample comprised of the most abundant taxon. In their final report EPA will use these metrics and a host of other biological data to develop an index, such as an index of biological integrity (IBI), to rate the condition of sampled rivers and streams as good, fair, or poor for key indicators of ecological and human health. While the data in table 3.6-6 alone cannot be used to rate the condition of the sampled sites, a general description can be formulated.

The Bellows Falls benthic data are representative of benthic communities found in large rivers. The relatively low taxa richness, low EPT richness, and high percent of dominant taxon, suggests the Claremont sample was collected in a predominately sandy substrate, a harsh environment for burrowing organisms due to sand grinding when the substrate shifts with the current. Compared to the Claremont sample, the metric values for the Cornish site suggest a more conducive environment for macroinvertebrates, perhaps a faster flow of water over a cobble and large gravel substrate.

In 1992 Vermont DEC collected macroinvertebrate data along the west bank of the Connecticut River using kick nets. One station was located 0.7 miles downstream of the Bellows Falls dam (Steve Fiske, Aquatic Biologist, Vermont DEC Biomonitoring Section, personal communication). Data calculated from the sample collection included density or abundance of macroinvertebrates, taxa richness, EPT richness, PMA-O and EPT/EPT + Chironomidae abundance (table 3.6-7). PMA-O is a measure of order-level similarity to a model based on reference stream conditions; values of 35 to 49 percent indicate moderately impaired conditions and values greater than or equal to 65 percent indicate non-impaired conditions (Novak and Bode, 1992). The EPT/EPT + Chironomidae Abundance metric is the ratio of the abundance of pollution intolerant EPT orders to the pollution tolerant Diptera family Chironomidae; higher values indicate less impaired conditions. These data indicate that in 1992 the tailwater of the Project was considered non-impaired.

Table 3.6-7. Data calculated from benthic samples collected in the Project affected area in 1992 by Vermont DEC (Source: Steve Fiske, Aquatic Biologist Vermont DEC Biomonitoring Section, personal communication).

Vermont DEC Site ID	Location	Density	Taxa Richness	EPT Richness	PMA-O	EPT / EPT + Chironomidae Abundance
CT-1300001724	0.7 mi below Bellows Falls Dam	1526.0	31.5	19.0	71.5	0.93

New Hampshire DES provided macroinvertebrate data collected in wadeable tributaries of the Connecticut River from 1997 to 2010 (D. Neils, New Hampshire DES Biological Monitoring Program Manager, personal communication). Samples were collected using artificial substrates (AS) such as rock baskets, and kick nets. Three kick net sample techniques were used: a kick net (K) was three to five 1-minute kicks in riffles only, composited into a single sample; multi-habitat (MH) was a 30 second kick in each habitat type proportional to the amount of each respective habitat type available; Environmental Monitoring and Assessment

Program (EMAP)[4] kick nets were collected from 11 equidistant transects within a study reach 40 times the channel width. For the EMAP, the placement of the kicks moved in a standardized fashion from river left to river center to river right, then back to river center to river left, etc., until each of the transects had been sampled. Effort per kick was about 1 minute or enough time to adequately sample a square with sides equal to the net's opening width.

The data set provided by New Hampshire DES was culled to include data that were collected: (1) after 2001 (i.e., data less than 10 years old) because benthic macroinvertebrate communities can be affected by changes in habitat and water quality, even over a short time; and (2) within one river-mile of the tributaries confluence with the Connecticut River, representing an upstream extent of the area potentially affected by the Project. One station, in the Little Sugar River fell into this category within the Project affected area (table 3.6-8).

Using baseline data from over 150 sample locations throughout the state, New Hampshire DES developed a multimetric Benthic Index of Biological Integrity (B-IBI) to rate the overall ecological integrity of the biological community. The B-IBI scores are then compared to an applicable threshold to determine aquatic community condition. B-IBI thresholds are based on the expected types and relative abundances of macroinvertebrates that naturally occur in streams and rivers in the absence of human disturbance. The aquatic community condition for the Little Sugar River site was found to be non-impaired (D. Neils, New Hampshire DES Biological Monitoring Program Manager, personal communication).

Table 3.6-8. New Hampshire DEC collection data for benthic samples collected in a tributary of the Project affected area (Source: D. Neils, New Hampshire DES Biological Monitoring Program Manager, personal communication).

Station ID	Waterbody	Approximate RM From CT River	Collection Date	Sample Type[a]	IBI / Threshold Score	Condition
NH HEX 17.03	Little Sugar River	0.7	25-Sep-06	AS	1.11	Non-impaired

[a] Sample Type: AS= artificial substrate.

3.6.8 Project Effects

Project effects can occur as a result of river fragmentation, passage mortality, impoundment, and hydroelectric operations. 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

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[4] EMAP is a research program run by EPA's Office of Research and Development to develop the tools necessary to monitor and assess the status and trends of national ecological resources.

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. Iterative development of downstream fish passage facilities have resulted in high guidance effectiveness for Atlantic salmon smolts to the downstream bypass and high bypass survival. Additionally, the length of the impoundment provides diverse habitats reducing the fragmentation effect, and, in general, the Project affected area is characterized by a rich and diverse fish community.

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. The modest increase in water surface area associated with tributary confluences and setbacks created by railroads and culverts can result in warmer water temperatures and consequently lower DO concentrations in those areas. In addition to the broad range of fish species present in main channel habitat, fish and aquatic species communities or life stages that favor more lentic conditions are also likely to reside in these setback areas. The normal reservoir operating range of approximately 2 feet daily in the Project impoundment minimizes fluctuations that could affect fish spawning habitat.

Daily Project operations and high water events could alter downstream habitat and impact species assemblages, feeding, spawning and recruitment, and migration patterns of fish. A diverse fish community exists below the dam and a notable fishery exists there, suggesting that the effects are limited.

Seven species, including the federally endangered dwarf wedgemussel, of freshwater mussel are found within the mainstem of the Connecticut River and near the mouth of mainstem tributaries. All seven of those have been identified in the Project affected area. Threats to mussel species include stranding from water level fluctuations, sedimentation and erosion. Because no changes are proposed to Project operations, no new effects on aquatic resources are anticipated.

3.6.9 References

ASMFC (Atlantic State Marine Fisheries Commission). 2010. Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management). ASMFC. Washington, D.C.

ASMFC. 2009. Amendment 2 to the Interstate Fishery Management Plan for Shad and River Herring. Prepared by Shad & River Herring Plan Review Team.

ASMFC. 2008. Addendum II to the Interstate Fishery Management Plan for American Eel. ASMFC, Washington, D.C.

ASMFC. 2006. Addendum I to the Interstate Fishery Management Plan for American Eel. ASMFC, Washington, D.C.

ASMFC. 2000. Interstate Fishery Management Plan for American Eel (Anguilla rostrata). Fishery Management Report No. 36 of the Atlantic State Marine Fisheries Commission. Washington, D.C.

ASMFC. 1985. Fishery Management Plan for American shad and river herrings. Fisheries Management Report No. 6 of the Atlantic States Marine Fisheries Commission. ASMFC. Washington, D.C.

Baum, E.T. 1997. Maine Atlantic Salmon: A National Treasure, 1st Ed. Hermon, ME: Atlantic Salmon Unlimited.

Beamish, F.W.H and T.E. Medland. 1988. Age determination for lampreys. Transactions of the American Fisheries Society 117: 63-71.

Biodrawversity and The Louis Berger Group, Inc. 2012. Freshwater mussel survey in the Connecticut River of the Vernon, Bellows Falls, and Wilder Hydroelectric Projects. Report submitted to TransCanada Hydro Northeast Inc.

Carrier J. and G. Gries. 2010. Spring walleye angler survey in the southern New Hampshire section of the Connecticut River (2008 & 2009). Grant No. F-50-R-26. New Hampshire Fish and Game Department.

Castro-Santos T. and B.H. Letcher. 2010. Modeling migratory energetics of Connecticut River American shad (Alosa sapidissima): implications for the conservation of an iteroparous anadromous fish. Canadian Journal of Fisheries and Aquatic Science 67: 806-830.

CRASC (Connecticut River Atlantic Salmon Commission). 2004. Management Plan for river herring in the Connecticut River Basin. Connecticut River Atlantic Salmon Commission, Sunderland, MA.

CRASC. 1998. Strategic plan for the restoration of Atlantic salmon to the Connecticut River. Connecticut River Atlantic Salmon Commission, Sunderland, MA.

CRASC. 1992. A Management Plan for American shad in the Connecticut River Basin. Connecticut River Atlantic Salmon Commission, Sunderland, MA.

CRJC (Connecticut River Joint Commissions). 2009. Update: Water Resources, Connecticut River Management Plan, Upper Valley Region. Connecticut River Joint Commission, Charlestown, NH. http://crjc.org/new%20WR3%20chapter/WATER_RESOURCES_UpperValley.pdf. (accessed September 7, 2012)

Daniels, R.A., K. Riva-Murray, D.B. Halliwell, D. Vana-Miller, and M.D. Bilger. 2005. An Index of Biological Integrity for northern mid-Atlantic slope drainages. Transactions of the American Fisheries Society 131:1044–1060.

Deen, D.L. 2009. Fish. Chapter 17 in Where the Great River Rises: An Atlas of the Upper Connecticut River Watershed in Vermont and New Hampshire . Brown

R.A., editor. Dartmouth College Press: University Press of New England, Hanover, NH.

EPA (U.S. Environmental Protection Agency). 2012. National Rivers and Streams Assessment. Home. EPA, May 2011. Web. 30 Aug 2012. http://water.epa.gov/type/rsl/monitoring/riverssurvey/index.cfm. (accessed September 10, 2012).

Facey, D.E. and M.J. Van Den Avyle. 1987. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic) - American eel. U.S. Fish and Wildlife Service Biological Report 82(11.74). U.S. Army Corps of Engineers, TR EL-82-4. 28 pp.

Fay, C., M. Bartron, S. Craig, A. Hecht, J. Pruden, R. Saunders, T. Sheehan, and J. Trial. 2006. Status review for anadromous Atlantic salmon (Salmo salar) in the United States. Report to the National Marine Fisheries Service and U.S. Fish and Wildlife Service. 294 pp.

Ferguson, M. 1999. Assessment of Dwarf Wedgemussel (Alasmidonta heterodon) distribution and habitat in large tributaries to the Connecticut River. 1999 Performance Report. Report submitted to the U. S Fish and Wildlife Service Region 5 Office, Hadley, MA.

Fichtel, C. and D.G. Smith. 1995. The Freshwater Mussels of Vermont. Vermont Fish and Wildlife Department Technical Report 18. Leahy Press, Montpelier, VT.

Flescher, D. and F.H. Martini. 2002. Lampreys: Family Petromyzontidae. Pages 16-20 in B.B. Collette and G. Klein-MacPhee, editors. Fishes of the Gulf of Maine, 3rd Edition. 748 pp.

FWS (U.S. Fish and Wildlife Service). 2012. Connecticut River Coordinators Office. http://www.fws.gov/r5crc/Fish/histStuff/migmaps.html. (accessed September 2012)

FWS. 2007. Dwarf Wedge Mussel, Alasmidonta heterodon, 5-Year Review: Summary and Evaluation. USFWS New England Field Office, Concord, NH.

Gephard S. and J. McMenemy. 2004. An overview of the program to restore Atlantic salmon and other diadromous fishes to the Connecticut River with notes on the current status of these species in the river. American Fisheries Society Monograph: 287-317.

Gries G. 2011. Young-of-the-year black bass assessments in Lake Winnipesaukee, Big Squam Lake, Forest Lake, Spofford Lake and the Connecticut River (Charlestown / Claremont Reach) (2010). New Hampshire Fish and Game Department. Sportfish Restoration Grant Report No. F-50-R-27. Anadromous and inland fisheries operational management investigations, Hanson B. 1999. Effectiveness of two surface bypass facilities on the Connecticut River to pass emigrating Atlantic salmon smolts. Chapter 2 in: Innovations in fish passage technology. American Fisheries Society, Bethesda, Maryland.

Hellyer, G. 2006. Connecticut River Fish Tissue Contaminant Study (2000) - Ecological and Human Health Risk Screening. Prepared for Connecticut River Fish Tissue Working Group. Ecosystem Assessment Unit, USEPA - New England Regional Laboratory, North Chelmsford, MA.

Jenkins R.E., and N.M. Burkhead. 1993. Freshwater fishes of Virginia. American Fisheries Society. Bethesda, MD.

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).

Kocik, J.F. and K.D. Friedland. 2002. Salmon and trouts: Family Salmonidae. Pages 170-180 in B.B. Collette and G. Klein-MacPhee, editors. Fishes of the Gulf of Maine, 3rd Edition. 748 pp.

Langdon, R.W., M.T. Ferguson, and K.M. Cox. 2006. Fishes of Vermont. Vermont Agency of Natural Resources. Waterbury, Vermont. 320 pp.

Martin E.H. and C.D. Apse. 2011. Northeast Aquatic Connectivity: an assessment of dams on northeastern rivers. The Nature Conservancy, Eastern Freshwater Program.

McMahon T.E., J.W. Terrell, and P.C. Nelson. 1984. Habitat suitability information: Walleye. U.S. Fish Wildl. Servo FWS/OBS-82/10.56. 43 pp.

Michaelson D.L., and R.J. Neves. 1995. Life History and habitat of the endangered dwarf wedgemussel Alasmidonta heterodon (Bivalvia:Unionidae). Journal of the North American Benthological Society 14:324-340.

Moser, A.G. 1993. Dwarf Wedgemussel (Alasmidonta heterodon) Recovery Plan. United States Fish and Wildlife Service, Northeast Region. http://ecos.fws.gov/docs/recovery_plan/dwm%20recovery%20plan.pdf. (accessed September 10, 2012).

Munroe T.A. 2002. Herrings: Family Clupeidae. Pages 111-159 in B.B. Collette and G. Klein-MacPhee, editors. Fishes of the Gulf of Maine, 3rd Edition. 748 pp.

Nedeau, E.J. 2008. Freshwater Mussels and the Connecticut River Watershed. Chapter 3: Status and Threats. Connecticut River Watershed Council, Greenfield, MA.

Nedeau E.J., M.A. McCollough, and B.I. Swartz. 2000. The Freshwater Mussels of Maine. Maine Department of Inland Fisheries and Wildlife, Augusta, Maine, USA.

NEFMC (New England Fishery Management Council). 1998. Essential Fish Habitat Description Atlantic salmon (Salmo salar). EFH Amendment. October 7, 1998.

New Hampshire Fish & Game. 2011a. New Hampshire Fish and Game Department Inland Fisheries Division 2011 Master Operational Plan.

New Hampshire Fish & Game. 2011b. New Hampshire fish stocking report for 2011. http://www.wildlife.state.nh.us/Fishing/Stocking/2011/full.html. (accessed September 10, 2012).

New Hampshire Fish & Game. 2010. New Hampshire fish stocking report for 2010. http://www.wildlife.state.nh.us/Fishing/Stocking/2010/full.html. (accessed September 10, 2012).

New Hampshire Fish & Game. 200. New Hampshire fish stocking report for 2009 http://www.wildlife.state.nh.us/Fishing/Stocking/2009/full.html. (accessed September 10, 2012).

New Hampshire Fish & Game. 2007. New Hampshire Wildlife Action Plan: Wildlife habitat maps and data with supporting documentation. Concord, N.H. http://www.wildlife.state.nh.us/Wildlife/wildlife_plan.htm. (accessed September 10, 2012).

New Hampshire Fish & Game. 1939. Biological survey of the Connecticut watershed. Survey Report No. 4. Concord, NH. 256 pp.

NMFS (National Marine Fisheries Service). 2009. Biological valuation of Atlantic salmon habitat within the Gulf of Maine Distinct Population Segment. National Marine Fisheries Service, Northeast Region. Gloucester, MA.

NMFS. 1999. 1999 Biological report on the status of Atlantic salmon.

Normandeau. 2011a. Atlantic salmon smolt report on fish sampling effort at Moore Dam, spring 2011. Report prepared for TransCanada Hydro Northeast, Inc., Concord, NH.

Normandeau. 2011b. Monitoring of migration of radio tagged adult Atlantic salmon in the Connecticut and Deerfield Rivers, 2011. Report prepared for TransCanada Hydro Northeast, Concord, NH.

Normandeau. 2010. Atlantic salmon smolt report on fish sampling effort at Moore Dam, spring 2010. Report prepared for TransCanada Hydro Northeast, Inc., Concord, NH.

Normandeau. 2009. Atlantic salmon smolt report on fish sampling effort at Moore Dam, spring 2009. Report prepared for TransCanada Hydro Northeast, Inc., Concord, NH.

Normandeau. 2008. Atlantic salmon smolt report on fish sampling effort at Moore Dam, spring 2007. Report prepared for TransCanada Hydro Northeast, Inc., Concord, NH.

Normandeau. 2007. Atlantic salmon smolt report on fish sampling effort at Moore Dam, spring 2006. Report prepared for TransCanada Hydro Northeast, Inc., Concord, NH.

Normandeau. 2006. Atlantic salmon smolt report on fish sampling effort at Moore Dam, spring 2005. Report prepared for TransCanada Hydro Northeast, Inc., Concord, NH.

Normandeau. 2005. Atlantic salmon smolt report on fish sampling effort at Moore Dam, spring 2004. Report prepared for USGen New England, Inc., Concord, NH.

Novak, M.A. and R.W. Bode. 1992. Percent model affinity, a new measure of macroinvertebrate community composition. Journal of the North American Benthological Society 11(1):80-85.

O'Brien, C. 2002. Inventory and monitoring of the dwarf wedgemussel (Alasmidonta heterodon) in the Connecticut River in New Hampshire and Vermont. Prepared for Nongame & Natural Heritage Program, Vermont Fish and Wildlife Department.

Ohio EPA (Environmental Protection Agency). 2006. Methods for assessing habitat in flowing waters: using the Qualitative Habitat Evaluation Index (QHEI). Ohio EPA Tech. Bull. EAS/2006-06- 1. Revised by Midwest Biodiversity Institute for Division of Surface Water, Ecological Assessment Section, Groveport, Ohio. 26 pp.

Pardue G.B. 1983. Habitat suitability index models: alewife and blueback herring. FWS/OBS-82/10.58, U.S. Department of the Interior, Fish and Wildlife Service.

Raleigh R.F. 1982. habitat suitability index models: Brook trout. U.S. Department of the Interior, Fish and Wildlife Service. FWS/OBS-82/10.24. 42 pp.

Rankin E.T. 1995. The use of habitat assessments in water resource management programs, pages 181-208. in W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Rankin, E.T. 1989. The qualitative habitat evaluation index (QHEI), rationale, methods, and application, Ohio EPA, Division of Water Quality Planning and Assessment, Ecological Assessment Section, Columbus, Ohio.

RMC. 1992. Movement and behavior of Atlantic salmon smolts at Wilder, Bellows Fall and Vernon Hydroelectric Stations and of American shad at Vernon Station. Report prepared for New England Power Company, Westboro, MA.

RMC. 1991. Survival of Atlantic salmon smolts passing the log-ice sluice at Bellows Falls Hydroelectric Station, Vermont. Report prepared for New England Power Company, Westboro, MA.

Scarola, J.F. 1973. Freshwater Fishes of New Hampshire. New Hampshire Fish and Game Department, Concord.

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

Scott, W.B. and E.J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada, Bulletin 184. 966 pp.

Smith, C.L. 1985. The inland fishes of New York State. New York State Department of Conservation, Albany, NY. 522 pp.

Smith, D.G. and K.A. Tighe. 2002. Freshwater eels: Family Anguillidae. Pages 92-95 in B.B. Collette and G. Klein-MacPhee, editors. Fishes of the Gulf of Maine, 3rd Edition. 748 pp.

Smithwood, D.A. 2004. Age Determination of Smallmouth Bass Sampled from the Connecticut River in 2000. Appendix A: Connecticut River Fish Tissue Contaminant Study (2000). U.S. Fish and Wildlife Service, Central New England Fishery Resources Office.

Sprankle, K. 1997. Connecticut River walleye population assessment and spring angler survey. 1996. F-50-R- Project 3, Job 2. New Hampshire Fish and Game Department. Concord, NH. 13pp.

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 82(10.88).

Strayer, D.L. and K. J. Jirka. 1997. The Pearly Mussels of New York State. New York State Museum Memoir 26.

Strayer D.L., S. Sprague, and S. Claypool. 1996. A range-wide assessment of populations of Alasmidonta heterodon, an endangered freshwater mussel (Bivalvia: Unionidae). Journal of the North American Benthological Society 15: 308-317.

USASAC (U.S. Atlantic Salmon Assessment Committee). 2011. Annual report of the U.S. Atlantic Salmon Assessment Committee. Report No. 24-2011. Turners Falls, MA. Prepared for NASCO.

Vermont Fish & Wildlife (Department of Fish & Wildlife). 2010a. Connecticut River Anadromous Fisheries Restoration and Management, Annual Report. Project No.: F-34-R-12. Study No. II: Fish Passage Operation, July 1, 2009 to June 30, 2010.

Vermont Fish & Wildlife. 2010b. Fish Distribution Report July 1, 2009 – June 30, 2010. Vermont Agency of Natural Resources.

Vermont Fish & Wildlife. 2009. Fish Distribution Report July 1, 2008 – June 30, 2009. Vermont Agency of Natural Resources.

Wicklow, B.J. 2005. Dwarf wedgemussel. Pages A26-A35 in: New Hampshire Wildlife Action Plan. New Hampshire Fish and Game Department. Concord.

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 I, Boston, MA. Center for Applied Bioassessment & Biocriteria. Midwest Biodiversity Institute. Columbus, OH.

3.7 WILDLIFE AND BOTANICAL RESOURCES

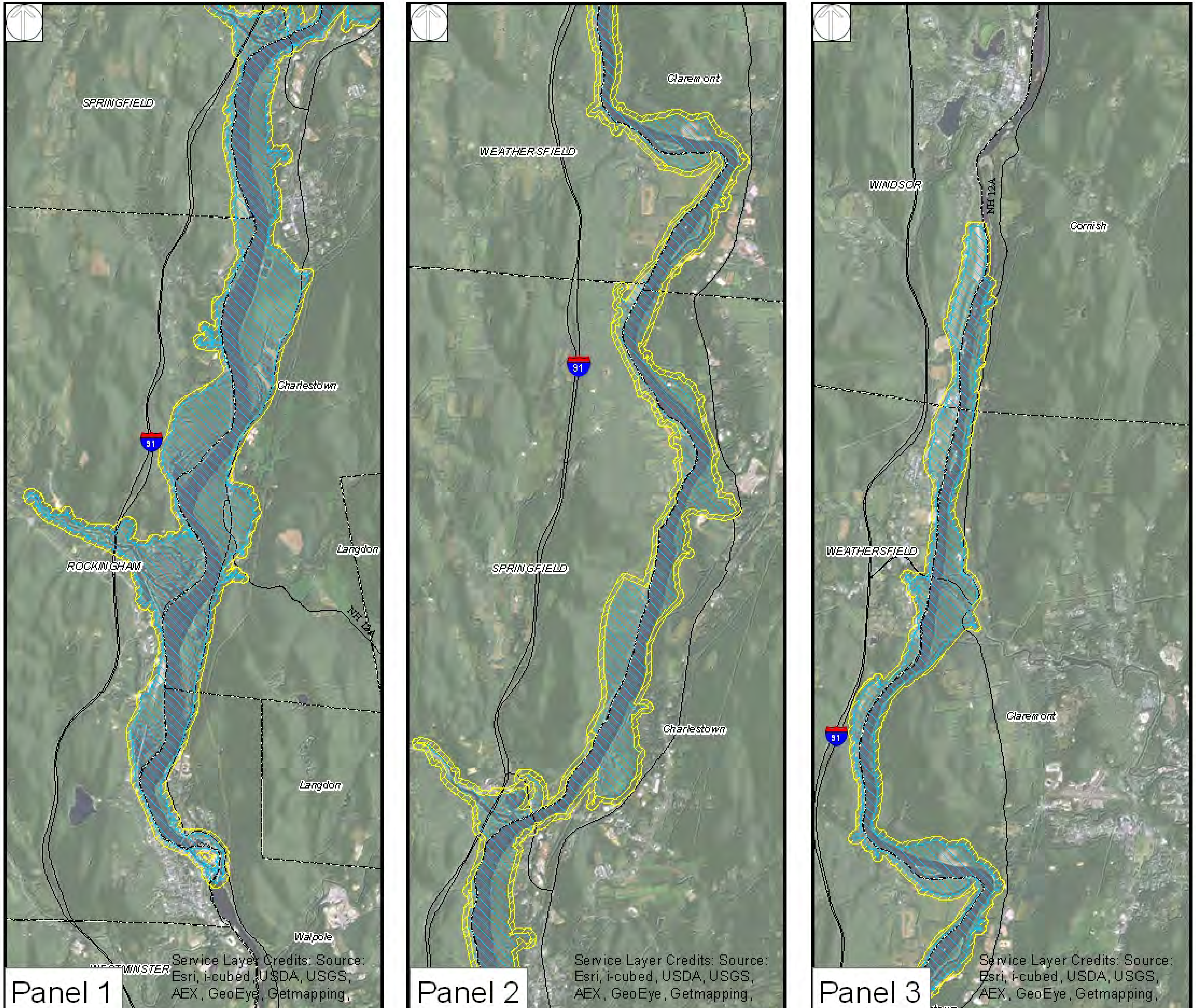
For wildlife and botanical resources, the subject area is referred to as the terrestrial project area and is defined as including lands with flowage easements retained by TransCanada and any land owned in fee by TransCanada, plus a 250-foot buffer around the resulting Project boundary (figure 3.7-1). This terrestrial project area extends from the top of the impoundment to about 0.5 mile below the dam.

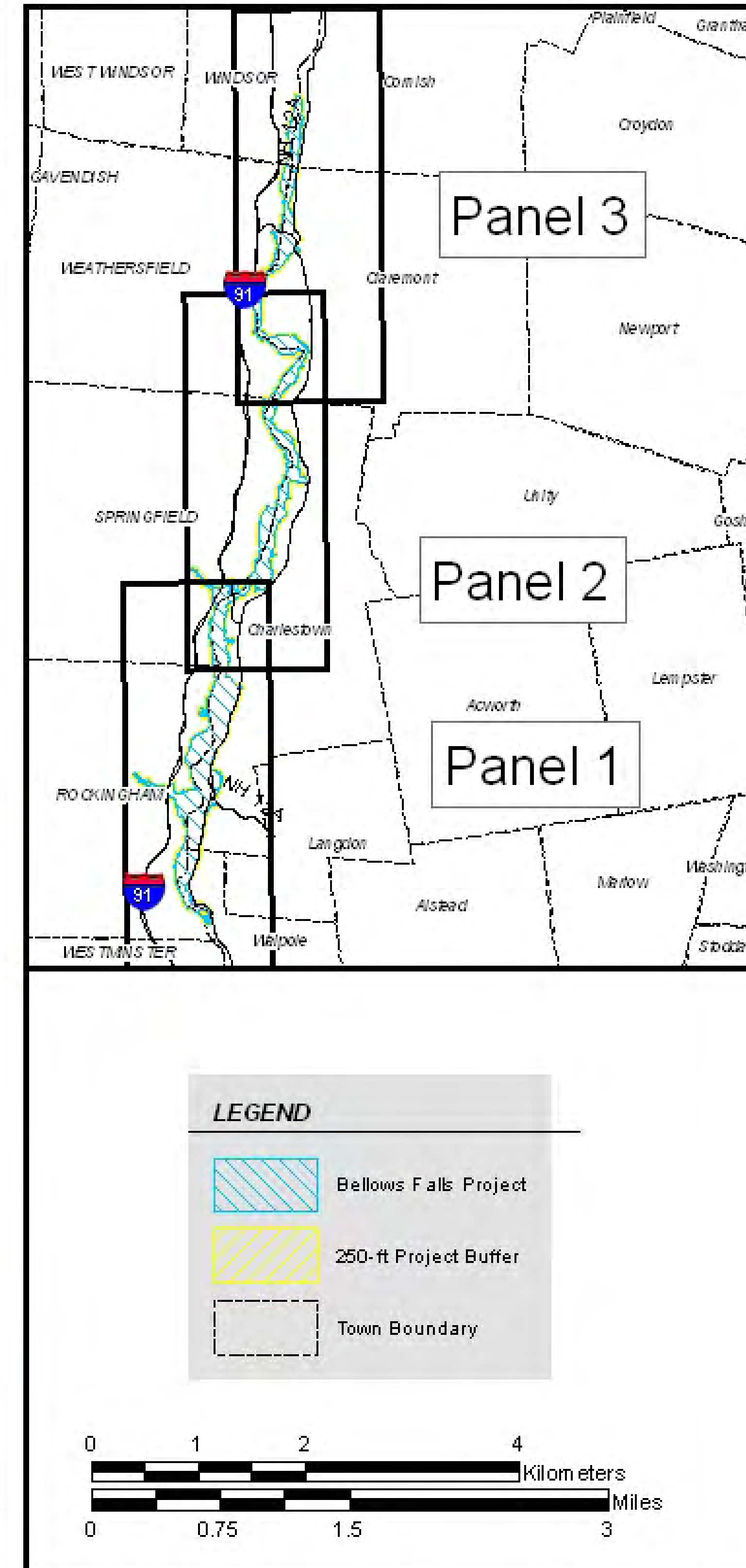
3.7.1 Summary of Existing Studies

The primary literature sources used to complete the wildlife and botanical resources section include:

- USGS land cover maps (Homer et al., 2007);
- the WAPs for New Hampshire and Vermont (New Hampshire Fish & Game, 2005; Kart et al., 2005),
- Vermont Ecological Hotspots layer (Vermont Biologic Diversity Project, 1999);
- New Hampshire WAP Tier Rankings (New Hampshire Fish & Game, 2008);
- Conservation Land maps from state-sponsored GIS data bases for both New Hampshire (UNH-CSRC, 2012) and Vermont (UNH-CSRC, 2012; UVM-SAL, 2009);
- Sperduto and Kimball's *The Nature of New Hampshire* (2011); and
- Thompson and Sorenson's *Wetland, Woodland, Wildland: A Guide to the Natural Communities of Vermont* (2000).

The USGS land cover layers have the benefit of using the same cover typing system in both states. This land use mapping system appears more focused on distinguishing agricultural and developed cover types. Therefore it combines all forested habitat into a single cover type, but identifies grassland and agricultural uses (pasture land and cropland), and several categories of urban/developed areas (figure 3.7-2). The New Hampshire WAP includes a map component, which allowed





TransCanada Hydro Northeast Inc.
Boundaries
Bellows Falls Project (NO.1855)

Prepared by Normandeau Team (09-10-12)

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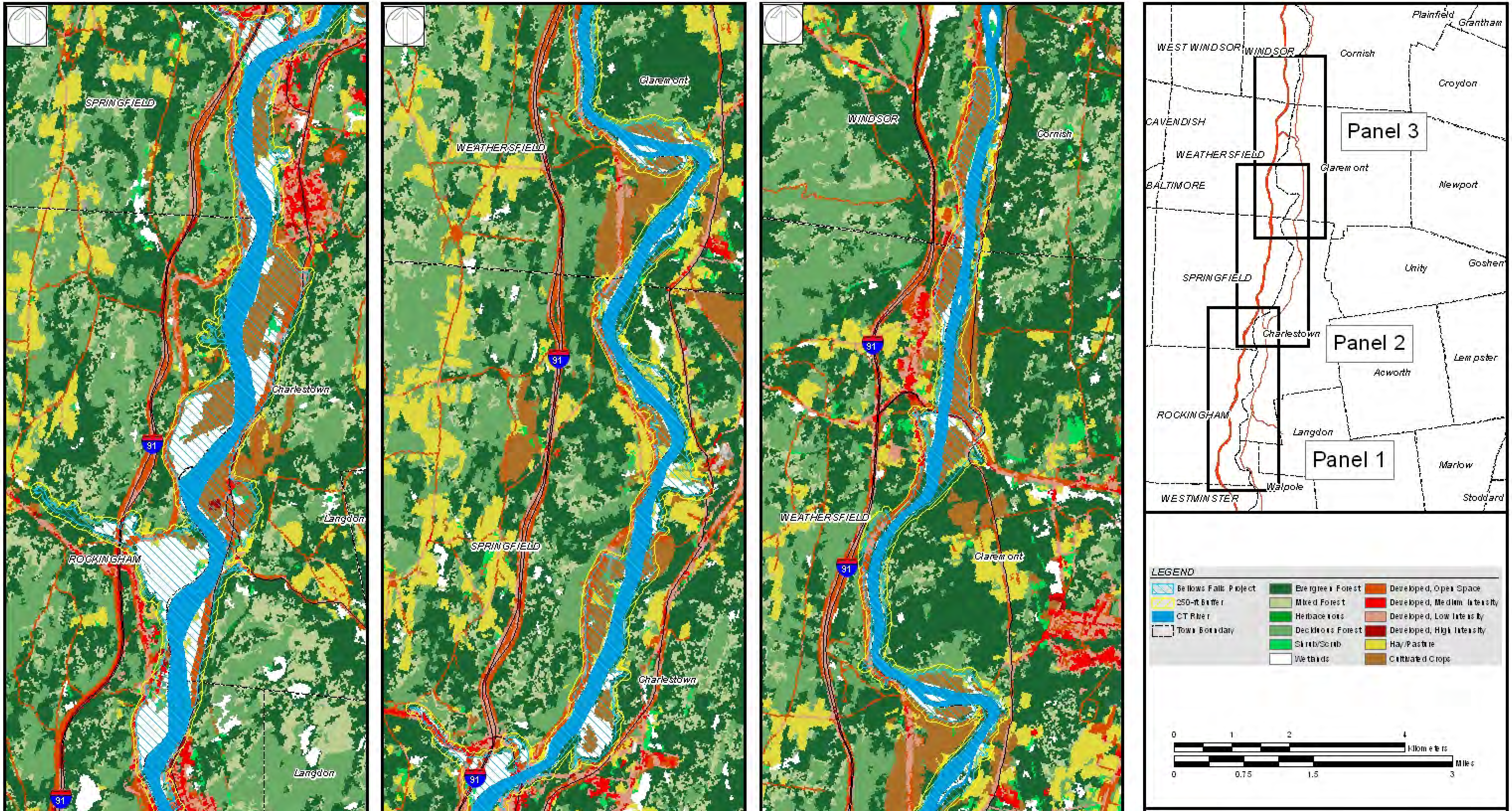

TransCanada Hydro Northeast Inc.
Land Cover
Bellows Falls Project (NO.1855)

Prepared by Normandeau Team (09-11-12)

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habitat types along the Connecticut River on the New Hampshire side to be evaluated. The Vermont WAP provides habitat descriptions but does not provide mapping, therefore cover types could only be inferred from the USGS maps. Because USGS provides only a single cover type for Forest, the Vermont WAP forested habitats could not be distinguished.

The total acreage of the terrestrial project area (Project Boundary plus 250-foot buffer) is approximately 4,757 acres, excluding the open water of the river. The acreages of the various cover types within the terrestrial project area using USGS maps, and their relationship to the New Hampshire and Vermont WAPs is provided in table 3.7-1. The general agreement was quite reasonable among the cover type boundaries within the three land use systems, although some discrepancies were observed. One that is significant to this Project are the railroad beds (several of which travel long stretches within the Project), utility rights of way and major roads, many of which are classified by USGS as “developed open space” with an approximately 200-foot wide buffer on either side. Many of these areas include lands that are mapped as various forest or grassland cover types in the New Hampshire and Vermont WAPs.

For information about habitat quality, we consulted the Vermont Ecological Hotspots layer (Vermont Biologic Diversity Project, 1999), the New Hampshire WAP Tier Rankings (New Hampshire Fish & Game, 2008), and the Conservation Land maps for both New Hampshire (UNH-CSRC, 2012) and Vermont (UNH-CSRC, 2012; UVM-SAL, 2009).

Table 3.7-1. Comparison of habitat and land cover layers among USGS, New Hampshire, and Vermont Land Cover Maps for the Project’s terrestrial project area.

USGS Land Cover	**New Hampshire WAP**	**Vermont WAP**	**Acres**
Forest (Mixed, Coniferous or Deciduous)	Appalachian Oak Pine Forest	Oak-Pine-Northern Hardwood Forest	1,488
	Hemlock Hardwood Pine Forest[a]	Hemlock-Northern Hardwood Forest	
	Floodplain Forest	Floodplain Forest	
Hay/Pasture	Grassland[a]	Grassland and Hedgerow	282
Cultivated Crops			1,388
Grassland/ Herbaceous			6

USGS Land Cover	New Hampshire WAP	Vermont WAP	Acres
Developed, High Intensity	*not mapped*	*not mapped*	31
Developed, Medium Intensity			208
Developed, Low Intensity			473
Developed, Open Space			831
Other			50
	Total Terrestrial Project Area		4,757

[a] New Hampshire WAP layers extending into Vermont.

3.7.2 Wildlife Habitats

Existing Upland Community Types

The terrestrial project area for the Project plus a 250-foot buffer is approximately 4,757 acres. The terrestrial project area supports a variety of habitat types and a diversity of land uses (see figure 3.7-2). Forested upland areas surrounding the Connecticut River at the Project are generally a mix of Hemlock Hardwood Pine and Appalachian Oak Pine (New Hampshire Fish & Game, 2005) and support numerous plant and wildlife species. In addition, hay and pasture lands create grassland habitats, particularly on the New Hampshire side of the project area. Adjacent to and sometimes within the project area, several large floodplain forests border the Connecticut River. Urban/suburban development, including roads and railroads, form a significant component of the landscape and affect wildlife use of the project area. Throughout the Project area, various types of disturbance and habitat edges create early successional habitats.

Forest

In the USGS land cover maps, the forest cover type includes all forested habitats on the New Hampshire and Vermont sides of the Connecticut River. Forest covers 1,488 acres (31 percent) of the terrestrial project area. The following sections describe dominant cover types identified in the New Hampshire and Vermont WAPs.

<u>Hemlock Hardwood Pine</u>. Hemlock Hardwood Pine communities are transitional forests found at elevations less than 1,500 feet (New Hampshire Fish & Game 2005). They lack many boreal species and central hardwood species but are dominated by hemlock (*Tsuga canadensis)* and white pine (*Pinus strobus*) along with American beech (*Fagus grandifolia*) and oak (*Quercus*) species. Common shrub species include low and highbush blueberries (*Vaccinium* species), witch hazel (*Hammamelis virginiana*) and beaked hazelnut (*Corylus cornuta*). Typical herbs of this community include starflower (*Trientalis borealis*), wild sarsaparilla (*Aralia*

nudicaulis), and Canada mayflower (*Maianthemum canadense*) (New Hampshire Fish & Game, 2005; Sperduto and Kimball, 2011).

The wildlife of a Hemlock Hardwood Pine forest uses the abundant botanical resources for food and cover (table 3.7-2). Moose (*Alces alces*) and white-tailed deer (*Odocoileus virginianus*) use understory trees for browse (Sperduto and Kimball, 2011; Thompson and Sorenson, 2000). Black bear (*Ursus americanus*) feed on beech nuts, acorns, blueberries, and dogwood (*Cornus spp*.) fruit. Vernal pools created in forested depressions provide breeding habitat for wood frogs (*Lithobates sylvatica*), spotted salamanders (*Ambystoma maculatum*), and a host of invertebrate species. Songbirds, such as vireo (*Vireo spp.*), ovenbird (*Seiurus aurocapillus*), and downy woodpecker (*Picoides pubescens*), breed in Hemlock Hardwood Pine forests (Sperduto and Kimball, 2011; Thompson and Sorenson, 2000).

<u>Appalachian Oak Pine</u>. Appalachian Oak Pine forests are associated with low elevations (less than 900 feet) and are most common in southern New Hampshire and southern Vermont in comparatively warmer, drier habitats (New Hampshire Fish & Game, 2005; Kart et al., 2005). Distinguishing tree species typically include black oak (*Quercus velutina),* white oak (*Quercus alba),* hickories *(Carya spp),* and pitch pine (*Pinus rigida*). Common shrub species are mountain laurel (*Kalmia latifolia)*, and dogwood. Typical herbaceous species are tick-trefoils (*Desmodium spp.)*, sweet goldenrod (*Solidago spp.)*, false foxgloves (*Agalinis spp.)* and wild indigo (*Baptisia australis)* (Sperduto and Kimball, 2011).

Appalachian Oak-Pine forests host a wide array of plant species, which in turn supports a diversity of wildlife. Mast consists primarily of crops of acorns and pine cones, creating an abundance of food. The leftover seeds germinate into young trees for browsers such as white-tailed deer and moose. When early successional breeding habitat is associated with Appalachian Oak-Pine forests, American woodcock (*Scolopax minor*) roost in trees on the forest edge (Sperduto and Kimball, 2011; DeGraaf and Yamasaki, 2001). Common birds in this forest type include tufted titmouse (*Baeolophus bicolor*), white-breasted nuthatch (*Sitta carolinensis*), hermit thrush (*Catharus guttatus*), and dark-eyed junco (*Junco hyemalis*) (DeGraaf and Yamasaki, 2001). The sandy, well-drained soils provide nesting habitat for Eastern painted turtles (*Chrysemys picta*) and snapping turtles (*Chelydra serpentina*) when appropriate wetland habitat is nearby.

<u>Floodplain Forest</u>. This community type is included in the Forest cover type under the USGS system, but is a separate cover type in both the New Hampshire WAP and the Vermont WAP. Floodplain forests occur in the lowlands bordering the Connecticut River with a primary canopy cover of silver maple, green ash or red maple. The estimated extent of this important riparian community type on the New Hampshire side of the terrestrial project area is 125 acres, based on mapped New Hampshire WAP data. Comparable data for Vermont is not available. A detailed account of this habitat type can be found in section 3.8.2, *Wetlands, Riparian, Littoral, and Floodplain Habitat*.

Grassland and Agricultural Lands. The USGS land cover map layers show 1,388 acres of cultivated crops, 282 acres of hay/pastureland, and 6 acres of grassland/herbaceous comprising 35 percent of the terrestrial project area (see figure 3.7-2). These categories are all combined as Grassland in the New Hampshire WAP, and a single cover type of Grassland and Hedgerow in the Vermont WAP. Grasslands under the state definitions are areas consisting primarily of grasses, sedges and other herbaceous plants with little tree or shrub cover (New Hampshire Fish & Game, 2005; Kart et al., 2005).

Grassland/herbaceous and pasture/hay provide valuable early successional habitat for wildlife. Wildlife commonly found in grassland/herbaceous and pasture/hay habitats include eastern cottontail (*Sylvilagus floridanus)*, common garter snake (*Thamnophis sirtalis)*, meadow vole (*Microtus pennsylvanicus)*, pickerel frog (*Rana palustris*), bobolink (*Dolichonyx oryzivorus)*, killdeer (*Charadrius vociferous)*, and American goldfinch (*Carduelis tristis)*. When grassland is adjacent to wetland, it can provide nesting habitat for common snapping turtles (*Chelydra serpentine)* and painted turtles (*Chrysemys picta)*. Grassland is declining in the northeast as previously farmed lands succeed to forest habitat and fire is suppressed (Kart et al., 2005).

Existing Upland Significant Habitats

Bald Eagle Breeding / Wintering. Bald eagles breed and overwinter in the Project vicinity. They 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. For a full species account, see section 3.9.4.

Migratory Songbird Stopovers. The Connecticut River serves as a migratory pathway for birds. As a north-south running feature, it serves as an important orientation tool for bird species during migration. Between 1996-1998, during 6 days of surveying, an average of 3,782 migratory birds were observed annually near the White River confluence with the Connecticut River just below Wilder dam (Litwin and Lloyd-Evans, 2006). The number of birds observed per survey was strongly correlated with proximity to the river, though the correlation was stronger at lower Connecticut River survey sites in Massachusetts (Litwin and Lloyd-Evans, 2006).

Locations within the terrestrial project area providing stopover habitat should be considered ecologically important habitat. One example is Herrick's Cove Important Birding Area in Rockingham, Vermont, which is owned and managed by TransCanada (NAS, 2012). A thick shrub understory provides excellent stopover habitat. The wide variety of available wetland also creates ideal waterfowl nesting habitat. More than 221 species have been observed in this location (NAS, 2012).

Unique Botanical Resources. The Connecticut River and its floodplains support a number of unique botanical habitats and resources. The banks of the river make fertile agricultural land and grassland habitat (Kart et al., 2005), but the conversion to agriculture comes at the cost of floodplain forest habitat. Several floodplain forest habitats are found within the Project area including Calavant Hill and Jarvis Hill. Floodplain forests are discussed in more detail in section 3.8.2, *Wetlands, Riparian, Littoral, and Floodplain Habitat*.

Large numbers of rare plant species are concentrated along the Connecticut River banks and floodplains, including the globally rare Jesup's milk vetch (*Astragalus* *robbinsii var jesuppi*), in which the only known occurrences of this species are at three locations along the river's bank on the free-flowing section below Wilder dam. Consultation with the Natural Heritage Bureaus of New Hampshire and Vermont has resulted in a total of 43 state-listed species identified within the Project boundaries, and including within 1,000 feet of the river edge (section 3.9, *Rare, Threatened, and Endangered Plants and Animals*). Of these, three are extant federally listed species, including dwarf wedgemussel (sections 3.6.7 and 3.9.4), northeastern bulrush (*Scirpus ancistrochaetus*) and Jesup's milk vetch. Both plant species are discussed in more detail in section 3.9.4.

3.7.3 Plant and Animal Species

Animal Species

Table 3.7-2 lists examples of wildlife species that are likely to occur in the vicinity of the Project.

Table 3.7-2. Representative wildlife species likely to occur in the Project's vicinity (Source: DeGraaf and Yamasaki, 2001).

Common Name	Basic Habitat Type
Birds	
Alder Flycatcher	Wetland
American Crow	Generalist
American Goldfinch	Grassland
American Robin	Generalist
American Woodcock	Grassland/Shrubland/Wetland
Baltimore Oriole	Grassland/Forest Edge
Bank Swallow	Riparian/Grassland
Barn Swallow	Grassland
Barred Owl	Forested
Belted Kingfisher	Riparian
Black-Capped Chickadee	Forested/Developed
Black-Throated Green Warbler	Forested
American Black Duck	Riparian/Open Water
Blue Jay	Generalist
Bobolink	Grassland
Broad-Winged Hawk	Forested
Brown-Headed Cowbird	Grassland/Forest Edge
Cedar Waxwing	Generalist
Common Yellowthroat	Shrubland/Wetland
Dark-Eyed Junco	Forested
Downy Woodpecker	Forested
Eastern Phoebe	Forested/Developed
Golden-Crowned Kinglet	Forested
Gray Catbird	Shrubland/Forest Edge
Great Blue Heron	Wetland/Riparian
Great-Crested Flycatcher	Forested/Forest Edge
Green Heron	Wetland
Hermit Thrush	Forested

Common Name	Basic Habitat Type
Birds	
Killdeer	Grassland
Mourning Dove	Generalist
Northern Cardinal	Generalist
Ovenbird	Forested
White-Breasted Nuthatch	Forested
Red-Eyed Vireo	Forested
Red-Tailed Hawk	Forested/Grassland
Red-Winged Blackbird	Wetland/Riparian
Rock Dove (Pigeon)	Developed
Rose-Breasted Grosbeak	Forested
Ruffed Grouse	Forested
Star-Nosed Mole	Forested/Wetland
Song Sparrow	Shrubland/Wetland
Swamp Sparrow	Wetland
Tufted Titmouse	Forested/Developed
White-Throated Sparrow	Forested
Wild Turkey	Forested/Grassland
Wood Duck	Forested/Wetland
Yellow-Rumped Warbler	Forested
Reptiles/Amphibians	
American Toad	Generalist
Bullfrog	Wetland
Common Snapping Turtle	Wetland/Open Water
Common Garter Snake	Grassland
Gray Tree Frog	Wetland/Forested
Green Frog	Wetland
Northern Red-Backed Salamander	Forested
Painted Turtle	Wetland/Open Water
Pickerel Frog	Wetland/Open Water
Red-Spotted Newt	Wetland/Forested
Ribbon Snake	Wetland
Spotted Salamander	Wetland/Forested
Spring Peeper	Wetland/Forested
Wood Frog	Wetland/Forested
Mammals	
Beaver	Forested/Wetland
Black Bear	Forested
Coyote	Generalist
Deer Mouse	Forested/Forest Edge
Eastern Chipmunk	Generalist
Eastern Cottontail	Grassland
Gray Squirrel	Generalist
Meadow Vole	Grassland
Mink	Riparian
Moose	Forested
Muskrat	Wetland

Common Name	Basic Habitat Type
Birds	
Northern Short-Tailed Shrew	Generalist
Raccoon	Generalist
Red Fox	Generalist
River Otter	Riparian
Snowshoe Hare	Forested
Star-Nosed Mole	Wetland
Striped Skunk	Forested/Developed
Virginia Opossum	Developed/Generalist
Water Shrew	Wetland/Stream
White-Tailed Deer	Forested
Woodchuck	Grassland/Forest Edge

Plant Species

Table 3.7-3 lists examples of native plant species that are likely to occur in the general vicinity of the Project. While this list is not comprehensive, it is representative of the high diversity of plant species and their habitats found within the terrestrial project area.

Table 3.7-3. Representative native plant species likely to occur in the Project's vicinity (Source: New Hampshire Fish & Game, 2005; Sperduto and Kimball, 2011; Kart et al., 2005)

Common Name	Scientific Name	Basic Habitat Type
American Beech	*Fagus grandifolia*	Hemlock Hardwood Pine
Aster	*Aster spp.*	Grassland
Big Bluestem	*Andropogon gerardii*	Grassland
Black Birch	*Betula lenta*	Appalachian Oak and Pine Forest/Hemlock Hardwood Pine
Black Cherry	*Prunus serotina*	Hemlock Hardwood Pine
Black Huckleberry	*Gaylussacia baccata*	Appalachian Oak and Pine Forest
Black Oak	*Quercus velutina*	Appalachian Oak and Pine Forest
Bracken	*Pteridium aquilinum*	Appalachian Oak and Pine Forest
Dangleberry	*Gaylussacia frondosa*	Appalachian Oak and Pine Forest
False Foxgloves	*Agalinis spp.*	Appalachian Oak and Pine Forest
Flowering Dogwood	*Cornus florida*	Appalachian Oak and Pine Forest
Round-Leaved Dogwood	*Cornus rugosa*	Appalachian Oak and Pine Forest
Goldenrod	*Solidago spp.*	Grassland
Gray Birch	*Betula populifolia*	Appalachian Oak and Pine Forest
Hemlock	*Tsuga canadensis*	Hemlock Hardwood Pine
Shagbark Hickory	*Carya ovata*	Appalachian Oak and Pine Forest
Hillside Blueberry	*Vaccinium pallidum*	Appalachian Oak and Pine Forest
Ironwood	*Ostrya virgininana*	Appalachian Oak and Pine Forest

Common Name	Scientific Name	Basic Habitat Type
Little Bluestem	*Schizachyrium scoparium*	Grassland
Lowbush Blueberry	*Vaccinium angustifolium*	Appalachian Oak and Pine Forest
Maple-Leaved Viburnum	*Viburnum acerifolium*	Appalachian Oak and Pine Forest
Meadowsweet	*Filipendula ulmaria*	Grassland
Mountain Laurel	*Kalmia latifolia*	Appalachian Oak and Pine Forest
Paper Birch	*Betula papyrifera*	Appalachian Oak and Pine Forest/Hemlock Hardwood Pine
Pennsylvania Sedge	*Carex pensylvanica*	Appalachian Oak and Pine Forest
Pin Cherry	*Prunus pensylvanica*	Hemlock Hardwood Pine
Pinweed	*Lechea spp.*	Appalachian Oak and Pine Forest
Pitch Pine	*Pinus rigida*	Appalachian Oak and Pine Forest
Poverty Oat-Grass	*Danthonia spicata*	Appalachian Oak and Pine Forest
Red Maple	*Acer rubrum*	Appalachian Oak and Pine Forest/Hemlock Hardwood Pine
Red Oak	*Quercus rubra*	Appalachian Oak and Pine Forest/Hemlock Hardwood Pine
Rough-Leaved Rice Grass	*Oryzopsis asperifolia*	Appalachian Oak and Pine Forest
Sassafras	*Sassafras albidum*	Appalachian Oak and Pine Forest
Scarlet Oak	*Quercus coccinea*	Appalachian Oak and Pine Forest
Scrub Oak	*Quercus ilicifolia*	Appalachian Oak and Pine Forest
Sessile-Leaved Bellwort	*Uvularia sessilifolia*	Hemlock Hardwood Pine
Sugar Maple	*Acer saccharum*	Hemlock Hardwood Pine
Sweet Fern	*Comptonia peregrina*	Appalachian Oak and Pine Forest
Tick-Trefoil	*Desmodium spp.*	Appalachian Oak and Pine Forest
White Ash	*Fraxinus americana*	Hemlock Hardwood Pine
White Oak	*Quercus alba*	Appalachian Oak and Pine Forest
White Pine	*Pinus strobus*	Appalachian Oak and Pine Forest/Hemlock Hardwood Pine
Whorled Loosestrife	*Lysimachia quadrifolia*	Appalachian Oak and Pine Forest
Wild Indigo	*Baptisia australis*	Appalachian Oak and Pine Forest
Wild Sarsaparilla	*Aralia nudicaulis*	Hemlock Hardwood Pine
Wintergreen	*Gaultheria procumbens*	Appalachian Oak and Pine Forest/Hemlock Hardwood Pine
Witch Hazel	*Hamamelis virginiana*	Appalachian Oak and Pine Forest/Hemlock Hardwood Pine
Woodland Sedge	*Carex blanda*	Appalachian Oak and Pine Forest
Yellow Birch	*Betula alleghaniensis*	Hemlock Hardwood Pine
Canada Mayflower	*Maianthemum canadense*	Appalachian Oak and Pine Forest

Birds of Conservation Concern

Table 3.7-4 lists the FWS-designated Birds of Conservation Concern (BCC) for Region 14 (Atlantic Northern Forests U.S. portion only), which includes the Project terrestrial project area (FWS, 2008). The BCC list identifies “species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973." The conservation concerns of these species may be the result of population declines, naturally or human-caused small ranges or population sizes, threats to habitat, or other factors (FWS, 2008).

Table 3.7-4. Birds of Conservation Concern for Region 14 and their potential to occur in the Project's vicinity (Source: FWS, 2008; Sibley, 2000).

Common Name	Scientific Name	Potential of Occurrence During Breeding Season
Red-Throated Loon	*Gavia stellata*	Unlikely
Pied-Billed Grebe	*Podilymbus podiceps*	Potential
Horned Grebe	*Podiceps auritus*	Unlikely
Greater Shearwater	*Puffinus gravis*	Unlikely
Great Cormorant	*Phalacrocorax carbo*	Unlikely
American Bittern	*Botaurus lentiginosus*	Potential
Least Bittern	*Ixobrychus exilis*	Potential
Snowy Egret	*Egretta thula*	Unlikely
Bald Eagle	*Haliaeetus leucocephalis*	Known
Peregrine Falcon	*Falco peregrinus*	Known
Yellow Rail	*Coturnicops noveboracensis*	Unlikely
Solitary Sandpiper	*Tringa solitaria*	Unlikely
Lesser Yellowlegs	*Tringa flavipes*	Unlikely
Upland Sandpiper	*Bartramia longicauda*	Unlikely
Whimbrel	*Numenius phaeopus*	Unlikely
Hudsonian Godwit	*Limosa haemastica*	Unlikely
Red Knot	*Calidris canutus*	Unlikely
Semipalmated Sandpiper (Eastern)	*Calidris pusilla*	Unlikely
Purple Sandpiper	*Calidris maritima*	Unlikely
Arctic Tern	*Sterna paradisaea*	Unlikely
Olive-Sided Flycatcher	*Contopus cooperi*	Unlikely
Bicknell's Thrush	*Catharus bicknelli*	Unlikely
Wood Thrush	*Hylocichla mustelina*	Potential
Blue-Winged Warbler	*Vermivora pinus*	Potential
Bay-Breasted Warbler	*Dendroica castanea*	Unlikely
Canada Warbler	*Wilsonia canadensis*	Potential
Nelson's Sharp-Tailed Sparrow	*Ammodramus nelsoni*	Unlikely
Saltmarsh Sharp-Tailed Sparrow	*Ammodramus caudacutus*	Unlikely
Rusty Blackbird	*Euphagus carolinus*	Unlikely

Based on their ranges and habitat preferences, eight species from the list have the potential to occur in the Project terrestrial project area during their breeding season. Several other species, including the bay-breasted warbler, the Bicknell's thrush, and the olive-sided flycatcher, likely use the Connecticut River as a migratory pathway, taking advantage of stopover habitat available within the terrestrial project area.

Invasive Species

The Connecticut River supports a relatively large number of invasive species. The Invasive Plant Atlas of New England (IPANE) identifies the species listed in table 3.7-5 as occurring in the general vicinity of the Project. Active management efforts to date by IPANE and the Silvio O. Conte National Federal Wildlife Refuge have largely focused on the lower Connecticut River Valley in the states of Connecticut and Massachusetts. However, Ibáñez et al. (2009) has constructed predictive modeling for southern New Hampshire and Vermont for three common invasive plants, and IPANE continuously monitors and accepts reports of invasive populations.

Table 3.7-5. Invasive plant species likely to occur in the Project's vicinity (Source: IPANE, 2012).

Common Name	Scientific Name	Habitat
Autumn-Olive	*Elaeagnus umbellata*	Field/Pasture, Gravel Pit, Early Successional Forest, Edge, Yard or Garden
Bell's Honeysuckle	*Lonicera x bella*	Field/Pasture, Early Successional Forest, Edge, Floodplain Forest, Open Disturbed Area, Yard or Garden
Black Swallowtail	*Cyanchum louiscae*	Riparian
Black Swallowwort	*Vincetoxicum nigrum (syn: Cynanchum louiseae)*	Field/Pasture, Forest, Edge, Floodplain Forest, Wetland
Common Reed	*Phragmites australis ssp. australis*	Emergent wetland
Curly Pondweed	*Potamogeton crispus*	Aquatic
Eurasian Water Milfoil	*Myriophyllum spicatum*	Aquatic
European Barberry	*Berberis vulgaris*	Field/Pasture, Early Successional Forest, Edge, Floodplain Forest

Common Name	Scientific Name	Habitat
European Buckthorn	*Rhamnus cathartica*	Field/Pasture, Early Successional Forest, Edge, Floodplain Forest, Open Disturbed Area, Yard or Garden
Garlic Mustard	*Alliaria petiolata*	Forest, Edge, Floodplain Forest, Roadside, Wet Meadow, Yard
Glossy Buckthorn	*Rhamnus frangula (syn: Frangula alnus)*	Field/Pasture, Early Successional Forest, Edge, Floodplain Forest, Wetland, Open Disturbed Area, Yard or Garden
Japanese Barberry	*Berberis thunbergii*	Field/Pasture, Early Successional Forest, Edge, Floodplain Forest, Wet Meadow
Japanese honeysuckle	*Lonicera japonica*	Upland forest
Japanese Knotweed	*Fallopia japonica (syn: Polygonum cuspidatum)*	Field, Early Successional Forest, Edge, Floodplain Forest, Wetland, Wet Meadow, Yard or Garden
Morrow's Honeysuckle	*Lonicera morrowii*	Field/Pasture, Early Successional Forest, Edge, Floodplain Forest, Open Disturbed Area, Yard or Garden
Multiflora Rose	*Rosa multiflora*	Early Successional Forest, Edge, Open Disturbed Area, Pasture, Yard or Garden
Oriental Bittersweet	*Celastrus orbiculatus*	Field/Pasture, Early Successional Forest, Edge, Yard or Garden
Purple Loosestrife	*Lythrum salicaria*	Emergent wetlands
Tatarian Honeysuckle	*Lonicera tatarica*	Field/Pasture, Early Successional Forest, Edge, Floodplain Forest, Open Disturbed Area, Yard or Garden
Winged Burning Bush	*Euonymous alatus*	Field/Pasture, Early Successional Forest, Edge, Yard or Garden
Yellowflag Iris	*Iris pseudacorus*	Floodplain, Wetland

3.7.4 Project Effects

Potential effects of the Project to wildlife and botanical 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, specific to the operating range, along the most 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. Most terrestrial wildlife and plant species utilize higher elevations and thus are above the influence of daily water level fluctuations. Areas of erosion along the riverbank can result in impacts to floodplains and riparian habitats. Such areas of erosion may also create nesting habitat opportunity for certain species, such as bank swallows. While the disturbance resulting from both daily project operations and high water events sustains the unique habitats that support RTE species, it also creates opportunities for invasive plant species to colonize and dominate the shorelines of the Project. Because no changes are proposed under the new project operation, no new effects to wildlife and botanical resources are anticipated.

3.7.5 References

DeGraaf, R.M. and M. Yamasaki. 2001. New England Wildlife: Habitat, Natural History and Distribution. University Press of New England. Hanover, NH.

FWS (U.S. Fish and Wildlife Service). 2008. Birds of Conservation Concern 2008. United States Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, Virginia. 85 pp. [Online version available at <http://www.fws.gov/migratorybirds/>].

Ibáñez, I. et al (2009). Multivariate Forecasts of Potential Distributions of Invasive Plant Species. Ecological Applications. Volume 19, Issue 2: pp. 359-375.

IPANE (Invasive Plant Atlas of New England). 2012. Data and Distribution Maps. http://www.eddmaps.org/ipane/distribution/. (accessed August 8, 2012).

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).

Litwin, T. and T. Lloyd-Evans. 2006. The Silvio O. Conte National Fish and Wildlife Refuge Neotropical Migrant Bird Stopover Habitat Survey. http://www.science.smith.edu/stopoverbirds/index.html. (accessed July 31, 2012).

NAS (National Audubon Society). 2012. Important Bird Areas in the U.S. Available at http://www.audubon.org/bird/iba (accessed June 22, 2012).

New Hampshire Fish & Game (New Hampshire Fish and Game Department). 2005. New Hampshire Wildlife Action Plan. Submitted to the U.S. Fish and Wildlife

Service on October 5, 2005. http://www.wildlife.state.nh.us/Wildlife/wildlife_plan.htm.(accessed July 31, 2012).

Sibley, D.A. 2000. The Sibley Guide to Birds. Alfred A. Knopf, New York, NY.

Sperduto, D. and B. Kimball. 2011. The Nature of New Hampshire: Natural Communities of the Granite State. University Press of New England. Hanover, NH.

UNH-CSRC (University of New Hampshire Complex Systems Research Center). 2012. Conservation/Public Lands [map]. Last updated March, 2012. http://www.granit.unh.edu/data/datacat/pages/consnh.pdf. (accessed June 7, 2010).

UVM-SAL (University of Vermont Spatial Analysis Lab). 2009. CadastralPublands_CONSPUB [map]. Last updated August 5, 2009. http://www.vcgi.org/dataware/. (accessed July 1, 2012).

Vermont Biologic Diversity Project. 1999. Biological Hotspots in Vermont [map]. Vermont Center for Geographic Information. Last updated March 1, 1999. http://www.vcgi.org/dataware/. (accessed July 1, 2012).

3.8 WETLANDS, RIPARIAN, LITTORAL, AND FLOODPLAIN HABITAT

3.8.1 Summary of Existing Studies

Mapping by the National Wetlands Inventory (NWI) was the primary source for describing the wetland and littoral vegetated habitats for the Project. Additional information was obtained from the USGS Land Cover Maps (Homer et al., 2007), and a TransCanada shoreline study (Kleinschmidt, 2011), although that data set was limited to point locations and general cover type. Riparian and floodplain habitats were obtained from the New Hampshire WAP and Vermont WAP, with associated descriptions supplemented by Sperduto and Kimball (2011). For these resources, the area referred to in this section of the PAD is termed the terrestrial project area, defined the same as that for section 3.7, including lands with flowage easements retained by TransCanada and any land owned in fee by TransCanada, plus a 250-foot buffer around the resulting Project boundary (see figure 3.8-1).

3.8.2 Habitats

Wetlands. Palustrine wetlands include all non-tidal freshwater wetlands dominated by trees, shrubs, persistent emergent vegetation, emergent mosses or lichens (Cowardin et al., 1979). They offer a variety of habitat types for wildlife from vegetated beaver ponds to open marshes to vernal pools. According to NWI maps, wetland habitats cover 490 acres of the terrestrial project area (figure 3.8-1). Wetland cover types are divided into three sub-categories: emergent (125 acres), scrub-shrub (115 acres), and forested (79 acres).

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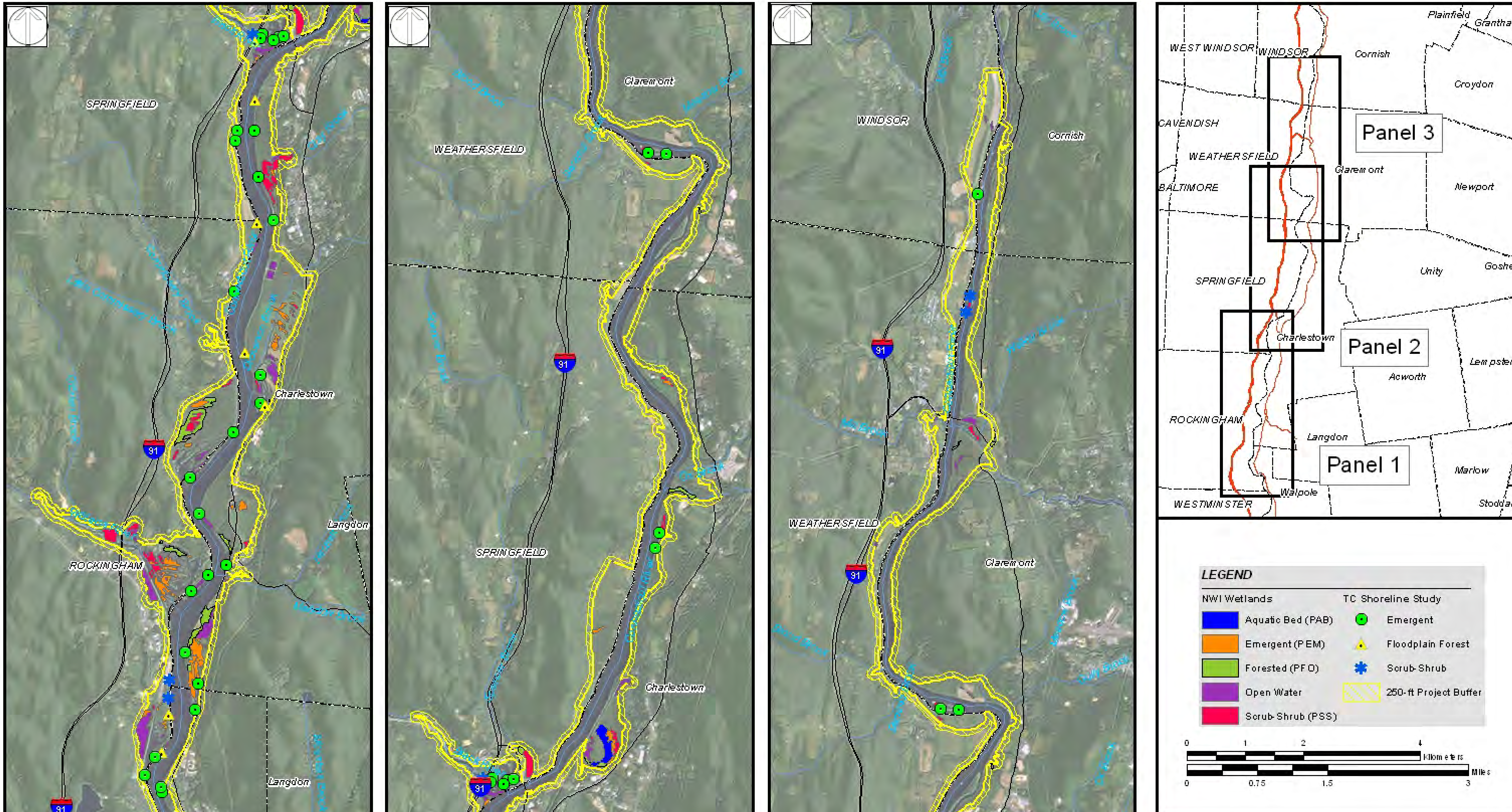

TransCanada Hydro Northeast Inc.
Wetlands
Bellows Falls Project (NO.1855)

Prepared by Normandeau Team (09-11-12)

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Emergent. Emergent wetlands are characterized by the presence of herbaceous hydrophytes for most of the growing season. These wetlands, often referred to as marshes, meadows, or fens, provide unique habitat features for many species. Some aquatic wildlife species, such as the spotted turtle (*Clemmys guttata*), prefer habitats with abundant emergent vegetation, because it provides them with good cover for foraging. Marshes adjacent to the river support muskrat, American black duck (*Anas rubripes)*, wood duck (*Aix sponsa)*, painted turtle, and bullfrog (*Rana catesbeiana)*. In semi-permanent emergent wetlands, bullfrog, pickerel frog, ribbon snake (*Thamnophis sauritus)*, and green heron (*Butorides virescens)* are common (DeGraaf and Yamasaki, 2001). Other wetland-dependent wildlife species commonly observed in emergent wetlands include green frog (*Rana clemitans*), beaver (*Castor canadensis*), red-spotted newt (*Notopthalmus viridescens*), and great blue heron (*Ardea herodias)*.

Scrub-Shrub. Scrub-shrub wetlands are dominated by woody vegetation less than 6 meters tall. Typical wildlife found in this wetland type includes grey tree frogs (*Hyla versicolor*) and spring peepers (*Pseudacris crucifer*) which will use scrub-shrub wetlands for breeding habitat. Some birds prefer to nest and feed in scrub-shrub wetlands, including the swamp sparrow (*Melospiza georgiana)*, alder flycatcher (*Empidonax alnorum),* and American woodcock. Many mammals use scrub-shrub wetlands during certain portions of the year, including black bear, moose, white-tail deer, raccoon (*Procyon lotor)* and mink (*Mustela vison)*. Smaller species such as water shrew (*Sorex palustris)* may live there for most of the growing season.

Scrub-shrub habitat often occurs in patches within another wetland type, so many generalist wetland species are also supported. Some other common species found in scrub-shrub habitat include red-spotted newt, wood frog, and green frog.

Forested. Forested wetlands are dominated by woody vegetation greater than 6 meters tall. Species that rely on upland forested habitat as part of their home range, such as deer, moose, and many songbirds, also inhabit forested wetlands. Some, though not all, forested wetlands function as vernal pools. These fishless temporary to semi-permanent aquatic basins serve as breeding grounds for a specific set of obligate species. When vernal pools become inundated with water in the spring, wood frogs and spotted salamanders lay eggs in the pools (Colburn, 2001). In addition to vernal pool obligate breeders, many of these other species can be found in forested wetlands: spotted turtle, red-spotted newt, moose, green frog, spring peeper, gray tree frog, star-nosed mole (*Condylura cristata)*, and shorebirds.

Riparian. For the purposes of this section, the term “riparian” shall be used to refer to anything connected or immediately adjacent to the shoreline or bank of the Connecticut River. Although the term “riparian buffer” generally refers to the naturally vegetated shoreline, floodplain or upland forest adjacent to a surface water body, the quantification of riparian habitat requires the calculation of a buffer size from which to base the numbers. The *New Hampshire Innovative Land Use Planning Handbook* suggests a minimum 50-foot buffer in order to cover the “middle core” natural riparian buffer for a greater than first order stream (Williams, 2008). Vermont ANR suggests a riparian buffer of 100 feet for streams with high potential vertical channel adjustment, riparian dependent species, significant riparian natural communities and increased risk of erosion (Vermont ANR, 2005). Lee et al. (2004) reviewed state and provincial riparian buffer requirements for the United States and Canada and found that buffer requirements ranged from 15.1 meters (49.5 feet) to 29 meters (95.1 feet). For acreage calculations in this document, we assumed a 100-foot buffer from the edge of the river.

The riparian zone can include floodplain, wetland (forested, scrub-shrub, or emergent), upland forest, or grassland (for detailed accounts of upland habitats, see section 3.7.2). The riparian zone serves as the primary interface between riverine and upland habitats, influencing both the primary productivity and food resources within the river. Principal wildlife resources associated with riparian habitats include early spring plant growth in lowland riparian habitats, which provide food sources for migrating birds, black bear, white-tailed deer, and otter (*Lutra canadensis)*. In addition, bank swallows (*Riparia riparia)* and belted kingfishers (*Ceryle alcyon)* dig nesting sites in sandy riparian areas adjacent to rivers (Sperduto and Kimball, 2011).

Table 3.8-1 shows the acreages associated with each riparian habitat type according to the USGS Land Cover maps (Homer et al., 2007). Approximately 2,593 acres (more than 80 percent) of the riparian zone at the Project comprises the Developed category, but 2,387 acres of that cover type is Open Space, which includes some rail corridors and roads running along portions of the river corridor. The Open Space cover type includes an approximately 200-foot wide buffer off the right-of-way, much of which is in natural or semi-natural habitat and will be used extensively by wildlife in the area. Development that extends to the river's edge can form a barrier to wildlife movement along the riparian corridor.

Table 3.8-1. Riparian habitat types and their associated acreages within 100 feet of the river's edge within the Project's terrestrial project area.

Habitat Type		Acres
Upland Forest (Deciduous, Evergreen, or Mixed)		194
Total Wetland		115[a]
	Woody	103
	Emergent/ Herbaceous	13
Grassland/Herbaceous		1
Pasture/Hay		18
Cropland		71
Developed (Open Space, Low, Medium, or High Intensity)		2,593
TOTAL		3,108

[a] NWI estimate uses a 100-foot riparian zone, smaller than the 250-foot terrestrial project buffer used in this section.

Floodplain. Floodplain forests occur in the regularly flooded valleys of major rivers or the floodplains of lakes. The soils in floodplain habitats are variable based on the exact location, but they tend to be exposed mineral soils, mineotrophic, and of alluvial origin (New Hampshire Fish & Game, 2005; Sperduto, 2011; Kart et al., 2005). A unique suite of flood-tolerant plant species characterizes this habitat type. When associated with large, high-gradient rivers like the Connecticut, the most common canopy cover is silver maple or sugar maple with a sparse shrub layer and a lush herbaceous layer dominated by either ostrich fern (*Matteuccia struthiopteris*) or sensitive fern (*Onoclea sensibilis*) depending on the gradient of the river (New Hampshire Fish & Game, 2005; Kart et al., 2005).

On the Connecticut River, the most common floodplain forest community is dominated by silver maple, wood nettle (*Laportea canadensis*), and ostrich fern (Sperduto and Kimball, 2011). In New Hampshire and Vermont, floodplain forests support many species at the northern edge of their range. This, in combination with the conversion of significant portions of floodplain habitat to agriculture, contributes to the rarity of many state-listed floodplain forest species (e.g., Green Dragon [*Arisaema dracontium*]) in New Hampshire and Vermont. In addition, the fragmented and sometimes disturbed nature of floodplain forests leaves them vulnerable to invasive exotic plant species (Kart et al., 2005).

Floodplain forests provide important nesting and migratory stopover habitats for birds. Bald eagles nest in large, tall floodplain trees, and silver maple floodplains attract nesting gray catbirds (*Dumetella carolinensis)*, song sparrow (*Melospiza melodia)*, and Baltimore orioles (*Icterus galbula*;)(Sperduto and Kimball, 2011). Warblers migrating northward feed on insects among the emerging maple leaves and flowers (Sperduto and Kimball, 2011). In addition, fish can become trapped in pools when floodwaters recede from floodplains, providing food for raccoons and other predators. These pools can provide breeding and foraging locations for a number of amphibians, reptiles and invertebrates, including wood turtle, wood frog, spotted salamander, ribbon snakes and a variety of insects.

Littoral. The littoral zone, in the context of a large river system, is the habitat between about a half-meter of depth and the depth of light penetration (Wetzel, 1975). The littoral width varies based on the geomorphology and rate of sedimentation of the stretch of river (Wetzel, 1983). Based on the NWI maps and the TransCanada Lower Connecticut River Shoreline study (Kleinschmidt, 2011), notable littoral habitats for wildlife were identified in several locations: the confluence of the Black River in Springfield, Vermont; the confluence of Clay Brook in Charlestown, New Hampshire; Great Meadows, Upper Meadows, and Lower Meadows in South Charlestown, New Hampshire, and Rockingham, Vermont; and Herrick's Cove, Meany's Cove, and Albee's Cove just upstream of the Bellows Falls dam. In addition, Nedeau (2006) reported submerged aquatic vegetation (SAV) to the north of the Route 5 bridge in Rockingham, Vermont and along the north side of the island just to the west of the bridge, indicating a locally wide littoral zone.

3.8.3 Project Effects

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 the most shorelines of the impoundment. Wetland and littoral resources in this zone are limited by the frequent wetting and drying. Floodplain and riparian habitats are generally situated at higher elevations and thus are above the influence of daily water level fluctuations. Areas of erosion along the riverbank can result in impacts to floodplains and riparian habitats. Such areas of erosion may also create nesting habitat opportunity for certain species, such as bank swallows. Because no changes are proposed under the new project operation, no new effects on wetland, floodplain, riparian, and littoral resources are anticipated.

3.8.4 References

Colburn, E. 2004. Vernal Pools. The McDonald and Blackwell Publishing Company. Blacksburg, VA.

Cowardin, L.M. et al. 1979. Classification of Wetland and Deepwater Habitats of the United States. United States Department of the Interior: Fish and Wildlife Service. December, 1979.

DeGraaf, R.M. and M. Yamasaki. 2001. New England Wildlife: Habitat, Natural History and Distribution. University Press of New England. Hanover, NH.

Homer, C., Dewitz, J., Fry, J., Coan, M., Hossain, N., Larson, C., Herold, N., McKerrow, A., VanDriel, J.N., and Wickham, J. 2007. Completion of the 2001 National Land Cover Database for the Conterminous United States. Photogrammetric Engineering and Remote Sensing, Vol. 73, No. 4, pp. 337-341.

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).

Kleinschmidt Associates. 2011. Lower Connecticut Shoreline Survey Report – 2010. Prepared for: TransCanada Hydro Northeast. 18 pp.

Lee, P., C. Smith and S. Boutin. 2004. Quantitative Review of Riparian Buffer Width Guidelines from Canada and the United States. Journal of Environmental Management. 70: pp 165-180.

Nedeau, E. 2006. Freshwater Mussels of the Upper Connecticut River, with Emphasis on the Federally Endangered Dwarf Wedgemussel (*Alasmidonta heterodon*). Prepared for Vermont Fish and Wildlife Department.

Sperduto, D. and B. Kimball. 2011. The Nature of New Hampshire: Natural Communities of the Granite State. University Press of New England. Hanover, NH.

Vermont ANR (Agency of Natural Resources). Guidance for Agency Act 250 and Section 248 Comments Regarding Riparian Buffers. Adopted December 9,

2005. http://www.anr.state.vt.us/site/html/buff/BufferGuidanceFINAL-120905.pdf. (accessed September 10, 2012).

Wetzel, R.G. 1983. Limnology: Second Edition. Saunders College Publishing. New York, NY.

Wetzel, R.G. 1975. Limnology. W.B. Saunders Company. Philadelphia, PA.

Williams, E. 2008. Innovative Land-Use Planning Techniques: A Handbook for Sustainable Development. NH Department of Environmental Services. http://des.nh.gov/organization/divisions/water/wmb/repp/innovative_land_use.htm. (accessed September 10, 2012).

3.9 RARE, THREATENED, AND ENDANGERED SPECIES

3.9.1 Summary of Existing Studies

Listings of all rare, threatened, and endangered species (RTE) and communities were obtained by request from map and database information provided by FWS, the New Hampshire Natural Heritage Bureau (New Hampshire NHB), and the Vermont Natural Heritage Information Project (Vermont NHIP). The request included lands within 1,000 feet of the river's edge, which for the purposes of this PAD will be referred to as the RTE project area. Habitat information was derived from the New Hampshire NHB's fact sheets and several flora manuals (Magee and Ahles, 2007; Seymour, 1969).

3.9.2 RTE Species in the RTE Project Area

The presence of RTE species in the Project's RTE project area was determined by consulting the map layers provided by the New Hampshire NHB and the Vermont NHIP. Table 3.9-1 shows the 43 federal and state-listed species that FWS and the states list as occurring in the RTE project area.

Table 3.9-1. Rare, threatened, and endangered species found within the Project's RTE project area.

Scientific Name	**Common Name**	**VT Status**[a]	**NH Status**[a]	**Federal Status**[a]	**Habitat**
Invertebrate Animals					
Alasmidonta heterodon	Dwarf wedgemussel	E	E	E	Variable-sized rivers with stable flow and substrate (MANHESP)
Cicindela marginipennis	Cobblestone tiger beetle	T	E		Sandy beaches on river's edge
Cicindela puritanab	Puritan tiger beetle[b]	T	T	T	Sandy beaches on river's edge
Vertebrate Animals					

Scientific Name	Common Name	VT Status[a]	NH Status[a]	Federal Status[a]	Habitat
Glyptemys insculpta	Wood turtle		SC		Meandering streams with sandy bottoms (DeGraaf and Yamasaki)
Haliaeetus leucocephalusc	Bald eagle[c]	E	T		Large lakes, rivers; large, riparian trees for nesting, roosting (DeGraaf and Yamasaki)
Rana pipiens	Northern leopard frog		SC		Wet open meadows, wet fields, river floodplains (DeGraaf and Yamasaki)
Plants					
Allium schoenoprasum	wild chives		E		Gravelly river shores and fields (Magee and Ahles).
Adlumia fungosa	Allegheny-vine		E		Wet or rocky woods; moist, calcareous ledges (Magee and Ahles)
Arabis pycnocarpa	Hairy eared-rockcress		E		Limestone ledges and rocks, rich woods, waste places (Magee and Ahles)
Arisaema dracontium	Green dragon	T	E		Floodplain forest (NHB) rich wet or mesic upland and alluvial woods (Magee and Ahles)
Asclepias quadrifolia	Four-leaved milkweed		E		Dry woods (Magee and Ahles)
Astragalus robbinsii var. jesupii	Jesup's milk vetch	E	E	E	River banks (Magee and Ahles)
Carex aurea	Golden-fruited sedge		T		Rich fens and seeps; rich wet meadows; calcareous riverside seeps (NHB) wet meadows, lake and river margins and wet, usually calcareous soil and rocks (Magee and Ahles)
Carex baileyi	Bailey's sedge		T		Rich fens and seeps; rich swamps; rich wet meadows (NHB) wet meadows, ditches and wet swampy woods (Magee and Ahles)
Carex garberi	Elk sedge	T	T		Calcareous riverside seeps (NHB)
Carex granularis	Limestone-meadow sedge		E		Rich fens and seeps; rich wet meadows (NHB) damp or rich deciduous woods, meadows, and

Scientific Name	**Common Name**	**VT Status[a]**	**NH Status[a]**	**Federal Status[a]**	**Habitat**
					pastures, often calcareous
Carex trichocarpa	Hairy-fruited sedge		E		Rich swamps (NHB) wet meadows and marshes (Magee and Ahles)
Cyperus squarrosus	Incurved umbrella sedge		E		Sandy pondshores / Sand plain basin marshes; Poor wet meadows; Southern riverbanks
Equisetum palustre	Marsh horsetail	T	E		Medium-depth and deep emergent marsh; rich wet meadows; calcareous riverside seeps (NHB); Shallow water, marshes, meadows, moist woodlands, streambanks and shores (Magee and Ahles)
Eupatorium sessilifolium	Upland thoroughwort	E	E		Woods and clearings (Magee and Ahles)
Galearis spectabilis	Showy orchid		T		Rich, deciduous woods (Magee and Ahles)
Hackelia virginiana	Virginia stickseed		E		Rich woods and thickets (Magee and Ahles)
Heteranthera dubia	Grass-leaved mud-plantain		T		Aquatic bed, southern riverbanks (NHB); Quiet water (Magee and Ahles)
Hydrophyllum virginianum	Eastern waterleaf		T		Rich, deciduous, often wet woods (Magee and Ahles)
Hypericum ascyron	Great St. John's-wort	T	E		Calcareous riverside seeps (NHB); pond and river thickets (Magee and Ahles)
Liparis loeselii	Loesel's wide-lipped orchid		T		Rich fens and seeps; Northern rich swamps; Rich wet meadows; Calcareous riverside seeps (NHB); Wet to dry meadows, thickets, and woods (Magee and Ahles)
Lobelia kalmii	Brook lobelia		T		Calcareous riverside seeps; rich wet meadows (NHB); Calcareous pond and stream margins, bogs, wooded swamps and wet ledges (Magee

Scientific Name	Common Name	VT Status[a]	NH Status[a]	Federal Status[a]	Habitat
					and Ahles)
Mimulus moschatus	Musky monkey-flower		E		Rich fens and seeps; riverbanks
Packera paupercula	Balsam groundsel		T		Rich fens and seeps; calcareous riverside seeps (NHB); cliffs, rocks, fields (Magee and Ahles)
Panax quinquefolius	American ginseng		T		Rich woods (Magee and Ahles)
Parnassia glauca	Fen grass-of-parnassus		T		Rich fens and seeps; rich wet meadows; calcareous riverside seeps
Physostegia virginiana	Obedient plant	T			Roadsides, fields, moist soil (Seymour), river edges, woodlands (Magee and Ahles)
Potamogeton nodosus	Long-leaved pondweed		T		Aquatic bed (NHB); shallow or deep ponds and streams (Magee and Ahles)
Potamogeton vaseyi	Vasey's pondweed		E		Aquatic bed (NHB); Quiet water (Magee and Ahles)
Potamogeton zosteriformis	Flat-stem pondweed		E		Aquatic bed (NHB); Ponds and sluggish streams (Magee and Ahles)
Pycnanthemum virginianum	Virginia mountain-mint		E		Fields, thickets, pond and river margins (Magee and Ahles)
Salix exigua ssp. interior	Sandbar Willow		E		River beaches and sandbars (Magee and Ahles)
Sanicula odorata	Clustered sanicle		E		Rich woods (Magee and Ahles)
Sanicula trifoliata	Large-fruited sanicle		T		Rich woods (Magee and Ahles)
Spiranthes lucida	Shining ladies'-tresses		E		Rich fens and seeps; rich wet meadows; calcareous riverside
Staphylea trifolia	American bladdernut		T		Rich woods and talus, floodplain forest; southern riverbanks
Stuckenia pectinata	Sago false pondweed		E		Aquatic bed, salt marshes, mudflats, and

Scientific Name	Common Name	VT Status[a]	NH Status[a]	Federal Status[a]	Habitat
					borders (NHB); shallow lakes, ponds and quiet rivers (Magee and Ahles); limey pools (Seymour)
Triantha glutinosa	Sticky false asphodel	T	E		Rich fens and seeps, calcareous riverside seeps (NHB); Damp ledges, bogs (Magee and Ahles)

[a] SC=Special Concern; T=Threatened; E=Endangered

[b] Species likely extirpated. The last individual was observed in 1932.

[c] Bald eagle is federally protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c)

3.9.3 Habitat Requirements and Critical Habitat Designations

No federal Critical Habitats have been designated in the Project's RTE project area. However, several habitat types within the RTE project area support populations of federally and/or state-listed species. As described in section 3.9.4, the federally endangered Jesup's milk vetch is limited to bedrock ledges within the scour zone of the Connecticut River. Calcareous seeps bordering the river support a number of state-listed species, including shining ladies tresses, elk sedge and brook lobelia. The large, rich floodplain forests bordering the Connecticut River support several state-listed species including green-dragon and eastern waterleaf. Sandy and gravel river banks provide habitat for the sandbar willow as well as cobblestone tiger beetle. Finally, marshy, littoral river margins provide habitat for pondweeds, pygmyweed and the pied-billed grebe.

3.9.4 Biological Opinions, Status Reports, and Recovery Plans

The following sections address the status and management efforts for federally listed species that occur within the RTE project area. The State of Vermont has developed recovery plans for several bird species known to utilize the area: the bald eagle, state-endangered (Vermont Fish & Wildlife, 2010), the peregrine falcon, no longer listed (Fowle, 2000) and the osprey, no longer listed (Parren, 1997). The State of New Hampshire does not have recovery plans for listed species, but does address their management in the New Hampshire WAP.

Bald Eagle. Several sections of the RTE project area provide both breeding and winter roosting habitat for bald eagles. Bald eagles are federally protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c) and the Migratory Bird Treaty Act and state-listed as Threatened in New Hampshire and Endangered in Vermont. Vermont's 2010 Bald Eagle Recovery Plan emphasizes monitoring, management and education to reach that state's goal of ultimately delisting the species.

During the winter, bald eagles move from nesting sites to coastal sites and inland locations with sufficient open water (DeGraaf and Yamasaki, 2001). Roosting sites generally consist of dense stands of east-facing softwood trees for optimal cover and morning sun exposure. According to the Vermont NHIP and New Hampshire NHB, bald eagles roost in several locations within the RTE project area: Chase Island in Cornish, New Hampshire and Windsor, Vermont, the Connecticut river confluence with the Sugar River, Jarvis Island in Claremont, New Hampshire, Hubbard Island in Claremont, New Hampshire and the complex of Great Meadows, Upper Meadows, and Lower Meadows in Charlestown, New Hampshire and Rockingham, Vermont. In 2012 during a 2-week long mid-winter eagle survey, a total of 15 eagles (12 adults, 3 immatures) were observed on the Connecticut River south of Wilder dam and north of the Massachusetts border (C. Martin, personal communication, January 12, 2012).

Bald eagles choose their nesting sites based on the proximity of large bodies of water with abundant fish resources, large trees for nest building, and they prefer minimal human disturbance (DeGraaf and Yamasaki, 2001). Two known bald eagle nesting territories exist within the Project area. In Rockingham, Vermont / Charlestown, New Hampshire, nesting has occurred since 2005 with three successful years and a total of five fledged young. A territory in Weathersfield, Vermont /Claremont, New Hampshire was discovered in 2011 with one successful fledgling but no nesting occurred there in 2012 (C. Martin, personal communication, August 14, 2012).

Dwarf Wedgemussel. A recovery plan has been written by FWS for this federally listed endangered species (Moser, 1993). The main goals of the plan are to protect and enhance habitat of current dwarf wedgemussel (*Alasmidonta heterodon)* populations and establish or expand populations within rivers or river corridors historically containing the species (Moser, 1993). The most recent 5-year review was published in 2007, retaining the species' status as federally listed as endangered (FWS, 2007).

Biodrawversity and LBG conducted a freshwater mussel survey from the upper limit of the Wilder Project to the lower limit of the Vernon Project, thus throughout the Bellows Falls Project in 2011 (Biodrawversity and LBG, draft 2012). The primary objectives were to assess the distribution, abundance, and demographics, and habitat of dwarf wedgemussel in this reach of the Connecticut River, as well as to gather information on co-occurring mussel species. A total of 46 sites were surveyed, one site below Bellows Falls dam and 45 sites within the Bellows Falls impoundment. Dwarf wedgemussels were found at nine survey sites (20 percent of sites), all in the upper half of the impoundment (Biodrawversity LLC and LBG, draft 2012). For more detail, see section 3.6.7, *Mussels and Macroinvertebrates*.

Northeastern Bulrush. Northeastern bulrush (*Scirpus ancistrochaetus*) is listed as endangered by the states of New Hampshire and Vermont, and nationally by FWS. It is known to occur in one location within the Project RTE project area on a beaver flowage in Rockingham, Vermont. While the specifics of its habitat preferences are unknown, FWS describes its typical habitat as "open seasonal pools surrounded by woodland" (FWS, 2008). The Rockingham site consists of beaver-controlled pools surrounded by emergent marsh (FWS, 1993). 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.

In the first 14 years since this species was listed by FWS, the number of known populations nationwide increased from 33 to 113, including from 1 to 9 in New Hampshire and from 2 to 22 in Vermont (FWS, 2008). FWS, Vermont NHIP, and New Hampshire NHB all agreed in an initial meeting to discuss rare species surveys on May 24, 2012, that northeastern bulrush was not likely to occur within the influence of Project operations, and should not be a priority for the rare species study (see *Rare Plant and Community Field Survey* section below).

Jesup's milk vetch. Jesup's milk vetch is a globally rare species listed as endangered by FWS and the states of Vermont and New Hampshire. It occurs naturally at only three known sites in the world, all along the Connecticut River below Wilder dam: Sumner Falls (Plainfield, New Hampshire); Jarvis Hill (Claremont, New Hampshire), and Hartland Ledges (Hartland, Vermont). The Jarvis Hill site lies within the Project's RTE terrestrial project area at the most upstream extent of the impoundment. Another site that lies above the RTE project area, Cornish Ledges in Cornish, New Hampshire, is an introduction site where Jesup's milk vetch establishment is being attempted. The three natural populations and the introduction site have been the subject of long-term monitoring by the New Hampshire NHB and Vermont NHIP based on the requirements of the initial Recovery Plan (FWS, 1989). Jesup's milk vetch grows in rock crevices within calcareous ledge along the upper reaches of the scour zone of the river (FWS, 2010). This perennial plant uses a taproot for stability and to hold nutrients. It is flood-tolerant, which allows it to out-compete many other species, but non-native species such as black swallowwort and Morrow's honeysuckle (*Lonicera morrowii*) are becoming a threat as they encroach on the rocky shoreline habitat on the Connecticut River (FWS, 2010).

In 2012, Normandeau, at the request of TransCanada conducted a hydrologic study to facilitate the states' long-term monitoring of the species. The study developed stage-discharge rating curves for the four sites relative to flows at the USGS West Lebanon gage with the goal of determining at what flows certain features may become inundated, such as established reference bolts and plant locations. This study found no evidence to suggest that normal operational flow ranges affect Jesup's milk vetch individuals or populations. The lowest Jesup's milk vetch plants grew at elevations that equated to 29,000 cfs at Jarvis Hill and 38,000 cfs at Sumner Falls site, which is approximately triple the daily operational flows from Wilder (700 to 10,500 cfs). The average yearly peak flow from 1970 to the present of 48,000 cfs corresponds reasonably well to the lower Jesup's milk vetch elevations. It follows that peak flows may be an important influence in the establishment or maintenance of Jesup's milk vetch plants. The detailed results of this survey will be available in late 2012.

Rare Plant and Community Field Survey. In the 2012 growing season, Normandeau, at the request of TransCanada, conducted a field survey for listed threatened or endangered plants and communities within the immediate environs of the Connecticut River. The survey area covered all three TransCanada projects (Wilder, Bellows Falls, and Vernon) and extended from the upper end of the Wilder impoundment to the downstream limit of the Vernon project. The survey assessed the current status of individual populations of all plant species listed by New Hampshire and Vermont that are potentially influenced by Project operations.

TransCanada consulted with FWS, New Hampshire NHB, and Vermont NHIP to define the appropriate level of effort and list of species to be included in this study. The purposes of the study are to: (1) document the presence or absence and status of these rare species; (2) identify additional locations of rare species in priority target habitats; and (3) to estimate their elevation relative to daily project operations to evaluate the potential influence of project operations on rare species and communities. The detailed results of this survey will be available in late 2012.

Individual occurrences of rare species and exemplary natural communities proximal to normal operational flows of the Wilder, Bellows Falls, and Vernon projects that were documented in this study correspond to one of three broad groups: (1) aquatic floating leaved and submerged species that remain inundated during daily operational flows; (2) aquatic to emergent species that are partially or entirely within the range of daily operational flows; and (3) species that are restricted wholly or in large part to areas on the riverbank above daily operational flows (inundated by flows exceeding normal operational maximum flows). Examples of each of these species were documented during the study.

Many rare plants species populations have apparently adapted to, tolerate, or rely on the existing flow regime associated with the particular zone they occur in. Given the length of time normal operational flows have been in place, it is likely that rare species intolerant of daily inundation either did not occur in this lower riverbank zone historically (i.e., prior to dam construction) or have since been relegated to areas either above or below the normal operational range, where habitat conditions remain suitable for the particular individual species. Some species (or individual populations) apparently tolerate or benefit from the daily inundation associated with normal operational flows.

3.9.5 Project Effects

Potential effects of the Project on RTE species or communities can occur as a result of hydroelectric operations. The average daily water level fluctuation of approximately 2 vertical feet has resulted in a zone of sparse vegetation, specific to the operating range, along the 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 scouring 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. 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.

Jesup’s milk vetch was documented by a TransCanada hydrologic study as occurring above the zone of daily Project operations (Normandeau, 2012a). This study found no evidence to suggest that normal operational flow ranges affect Jesup’s milk vetch individuals or populations. The lowest Jesup’s milk vetch plants in 2012 grew at elevations that equated 29,200 cfs at Jarvis Hill to 38,000 cfs at

Sumner Falls, which is approximately triple the daily operational flows from the upstream Wilder Project (700 to 10,500 cfs). The average yearly peak flow in this section of the river from 1970 to the present (48,000 cfs) corresponds reasonably well to the lower Jesup's milk vetch elevations. It follows that peak flows may be an important influence in limiting the establishment and maintenance of plants to infrequently flooded elevations on the riverbank.

Another factor influencing Jesup's milk vetch growth is the presence of invasives such as black swallowort, which thrives in similar conditions preferred by Jesup's milk vetch. The New Hampshire and Vermont heritage bureaus are employing active vegetation management techniques including the use of approved herbicide and removing black swallowwort during the growing season on a periodic basis. Poison ivy is an aggressive native plant species that is also encroaching on the Jesup's milk vetch site at Cornish Falls.

A second TransCanada field study of rare plants and communities is determining the distribution of plants and communities bordering the river within the Project. Many rare plants species populations have apparently adapted to, tolerate, or rely on the existing flow regime associated with the particular zone they occur in. Given the length of time normal operational flows have been in place, it is likely that rare species intolerant of daily inundation either did not occur in this lower riverbank zone historically (i.e., prior to dam construction) or have since been relegated to areas either above or below the normal operational range, where habitat conditions remain suitable for the particular individual species. Some species (or individual populations) apparently tolerate or benefit from the daily inundation associated with normal operational flows.

Because no changes are proposed to Project operations, no new effects on rare state or federal terrestrial plant species or communities resources are anticipated.

3.9.6 References

Brackley, F.E, 1989. Jesup's Milk Vetch Recovery Plan, United States Fish and Wildlife Service, Northeast Region. http://ecos.fws.gov/docs/recovery_plan/891121.pdf. (accessed October 15, 2012).

Biodrawversity and LBG (Biodrawversity LLC and the Louis Berger Group, Inc.). 2012. Freshwater Mussel Survey in the Connecticut River for Vernon, Bellows Falls, and Wilder Hydroelectric Projects. Prepared for TransCanada Hydro Northeast Inc.

DeGraaf, R.M. and M. Yamasaki. 2001. New England Wildlife: Habitat, Natural History and Distribution. University Press of New England. Hanover, NH.

Fowle, M.R. 2000. Vermont Peregrine Falcon Recovery Plan. National Wildlife Federation, Montpelier, VT, and Vermont Department of Fish and Wildlife, Waterbury, VT.

FWS (U.S. Fish and Wildlife Service). 2010. Jesup's Milk-Vetch *Astragalus robbinsii var. jesupii*: Fact Sheet. http://www.fws.gov/northeast/pdf/Jesups_milkvetch_1010.pdf. (accessed September 6, 2012).

FWS. 2008. Birds of Conservation Concern 2008. United States Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, Virginia. 85 pp. http://www.fws.gov/migratorybirds/NewReportsPublications/SpecialTopics/BCC2008/BCC2008.pdf (accessed October 23, 2012) .

FWS. 1989. Jesup's Milk-Vetch (*Astragalus robbinsii var. jesupii*) Recovery Plan. U.S. Fish and Wildlife Service, New England Field Office. Prepared by Frankie Brackley, New Hampshire Natural Heritage Inventory.

Magee, D.W. and H.E. Ahles. 2007. Flora of the Northeast: A Manual of the Vascular Flora of New England and Adjacent New York. University of Massachusetts Press. Amherst, MA.

Martin, C. 2010. Status of Breeding Bald Eagles in New Hampshire in 2010. Prepared for NH F&G, Nongame and Endangered Wildlife Program. http://www.nhaudubon.org/wp-content/uploads/2011/02/2010-NH-Breeding-BAEA-Final-Report-no-app.pdf. (accessed October 15, 2012).

Moser, A.G. 1993. Dwarf Wedgemussel (*Alasmidonta heterodon*) Recovery Plan. United States Fish and Wildlife Service, Northeast Region. http://ecos.fws.gov/docs/recovery_plan/dwm%20recovery%20plan.pdf (accessed September 10, 2012).

Parren, Steven G. 1997. Vermont Osprey Recovery Plan. Vermont Fish and Wildlife Department, Waterbury, VT.

Sibley, D.A. 2000. The Sibley Guide to Birds. Alfred A. Knopf, New York, NY.

Vermont F&W. 2010. Vermont Bald Eagle Recovery Plan. Vermont Fish and Wildlife Department, Waterbury, VT.

3.10 RECREATION AND LAND USE

3.10.1 Summary of Existing Studies

This section reviews the numerous existing recreation facilities and opportunities adjacent to the Project boundary as well as within a regional context (defined as 60 miles from the Project, discussed in more detail in the subsection below) and places them within the context of existing recreation use data, buffer zones, and identified recreation needs. This section also examines non-recreation land use and management on Project lands, as well as adjacent to the Project boundary. TransCanada defined the Project's affected area for recreation and land use as

Bellows Falls reservoir within the Project boundary and about 0.5 mile downstream of Bellow Falls dam.

The following sources of information were used to describe the recreation resources of the Project affected area:

- Bellows Falls Exhibit R Maps;
- Connecticut River Corridor Management Plan, Recreation Plan, Water Resources Plan, and Boating on the Connecticut River maps;
- New Hampshire and Vermont Statewide Comprehensive Outdoor Recreation Plans (SCORPs);
- Regional planning documents, including management plans from: Windham Regional Commission; Southern Windsor County Regional Planning Commission; Upper Valley Lake Sunapee Regional Planning Commission; and the Southwest Region Planning Commission;
- Rockingham and Walpole town plans;
- FERC Licensed Hydropower Development Recreation Report – Form 80s;
- New Hampshire walleye creel survey data; and
- Aerial photos, topo maps, USGS maps, Connecticut River Paddler Trail map info, and Google Earth.

3.10.2 Existing Recreational Facilities and Opportunities

Recreation facilities and opportunities in the Project affected area are largely enjoyed by visitors originating from the towns and communities throughout the Connecticut River Valley including Vermont, New Hampshire, and Massachusetts. Interstate Route 91 and U.S. Route 5 run along the Vermont side of the valley, while NH Route 12 runs along the New Hampshire side. The tracks of the Boston and Maine Railroad run along the New Hampshire side, and the tracks of the Green Mountain Railroad Corporation run along the Vermont side before branching off toward central Vermont at the Williams River. These railroad tracks make recreation access difficult to many acres along the reservoir. Recreation facilities and opportunities within the Project boundary are shown on figure 3.10-1. Recreation access to Project lands and waters is provided by a variety of managing entities including state, municipal, non-governmental agencies, private landowners, and TransCanada.

Project Facilities and Opportunities in the Project Area

Popular recreation activities in the Connecticut River Valley include camping, fishing, boating/floating, swimming, hiking, bicycling, picnicking, sightseeing, wildlife viewing, canoe/kayaking, snowmobiling, cross-country skiing, and hunting. The Project affected area's primary recreation facilities and use are focused around the Connecticut River including Bellows Falls reservoir. The Connecticut River Water Trail travels along the full length of the Connecticut River in Vermont and New Hampshire. CJRC publishes boating maps and information on-line while the Connecticut River Watershed Council has published *The Connecticut River Boating Guide: Source to Sea* (third edition 2007) a map and guidebook of this entire trail for boating enthusiasts (http://www.ctriver.org/publication/boating%20guide/index.html).

Bellows Falls reservoir extends north from the Bellows Falls dam about 26 miles to the town of Weathersfield, Vermont (see figure 2.1, *General Location*, for general reference). The reservoir has about 72 miles of shoreline with a surface area of 2,804 acres at a normal elevation of 291.63 feet and is largely surrounded by private lands. The Project is situated in parts of eight communities - Walpole, Charlestown, Claremont, and Cornish in New Hampshire, and Rockingham, Springfield, Weathersfield, and Windsor in Vermont. Recreation access to the reservoir is provided in seven of the eight communities in the Project (access is not provided in Windsor, Vermont).

The primary activities that occur at the Bellows Falls reservoir include camping, fishing, hiking, boating (motorized and canoe/kayaking), swimming, hunting, and winter sports such as ice fishing, snowmobiling and cross-country (Nordic) skiing and ice skating. Boating on the reservoir is very popular with access points for both trailered motor boats and car top/hand launch canoe/kayak trips. Table 3.10-1 summarizes the Project and Project-related public recreation facilities that provide access to the Project. Project recreation sites are those owned and managed by TransCanada and contained within the existing FERC-approved exhibit R recreation maps while Project-related are those that are adjacent to or provide access to Bellows Falls reservoir or other Project lands. Most of the recreation sites are modest with few amenities other than access to the river to fish or launch a boat.

Sumner Falls, a series of ledges about 8 miles upstream from the Project boundary, attracts kayakers to play and practice in the quarter-mile whitewater play spot. A portage on the Vermont side, on land owned by the town of Hartland, Vermont, offers a way to avoid this hazard and often serves as a starting or ending point for day trips (CRJC, 2008). Additional discussion on Sumner Falls is provided in the PAD for the Wilder Project.

According to CRJC (2008), the reach below Wilder dam to the Ascutney Bridge in Weathersfield/Claremont (a distance of about 20 miles), which includes the northernmost portion (about 3.5 miles) of the Project, offers some of the best canoeing and kayaking anywhere on the entire Connecticut River. The river here has a lively current, offering pleasant and easy paddling and is mostly Class I, quick flatwater, with a few Class II riffles (CRJC, 2008).

Between the Ascutney Bridge and the Bellows Falls dam, where the current slows as it enters the impoundment, the river is well used by both power boats and canoes. According to CRJC (2008), the river above the Cheshire Bridge is too narrow for water skiing.

New Hampshire boating law, which apply to the Connecticut River specifies boats may not exceed headway speed (no-wake, or 6 mph) within 150 feet (300 feet for

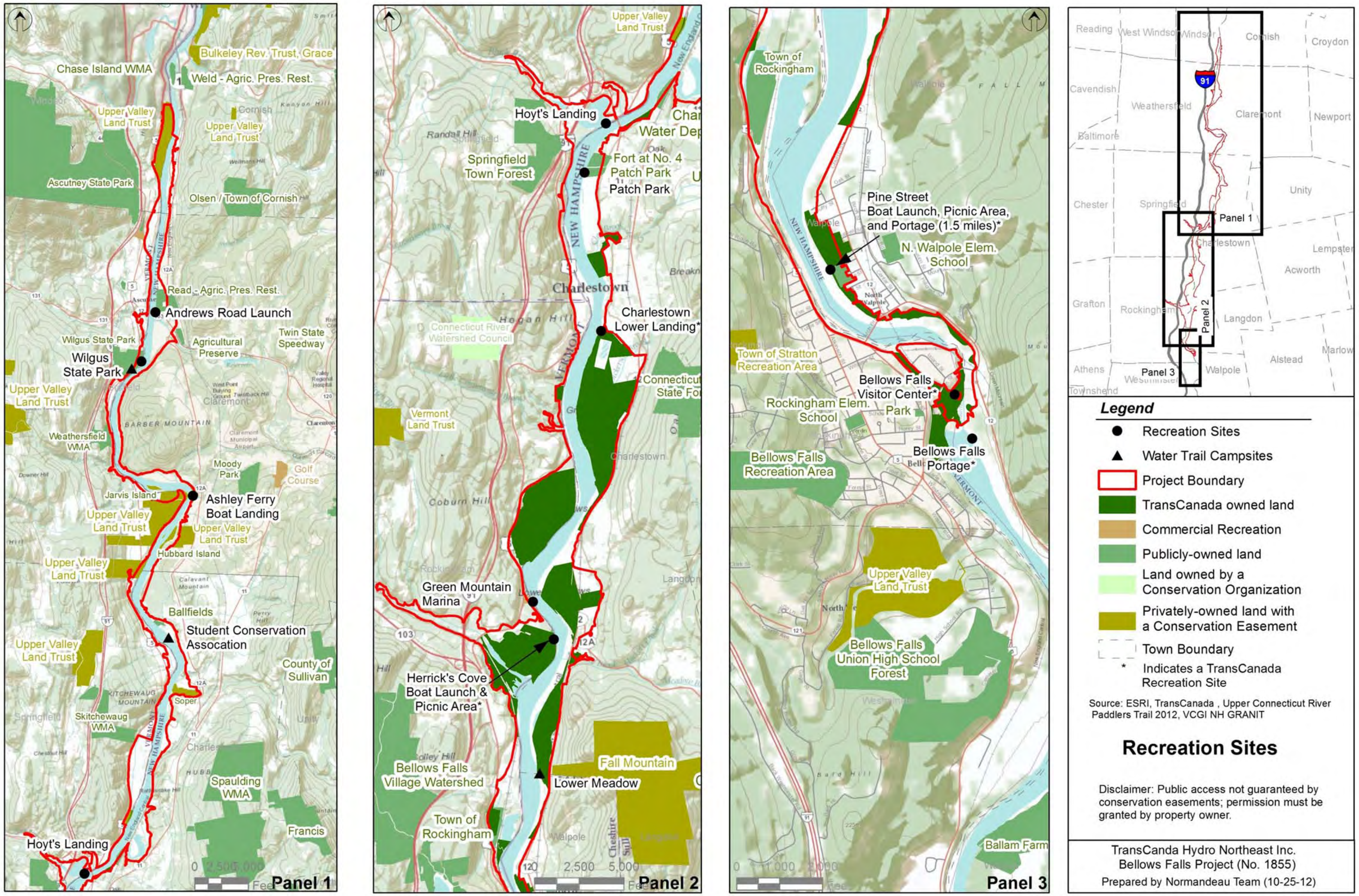

Figure 3.10-1. Recreation sites and lands within the Project vicinity.

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Table 3.10-1. Recreation sites within the Project boundary (Source: CRJC, 2008).

Site Name	Site Type	RM	Town	Manager
Andrews Road	Boat ramp (cartop)	192	Claremont, NH	State of NH
Wilgus State Park	Boat ramp (cartop)	191	Weathersfield, VT	State of VT
Ashley Ferry Boat Landing	Boat ramp	187	Claremont, NH	State of NH
Hoyts Landing	Boat ramp and fishing platform	179	Springfield, VT	State of VT
Patch Park	Boat ramp (cartop, unimproved)	178	Charlestown, NH	Town of Charlestown
Charlestown Boat Launch and Picnic Area[a]	Boat ramp and picnicking	177	Charlestown, NH	TransCanada
Green Mountain Marina	Boat ramp and marina	173.5	Rockingham, VT	Private
Herrick's Cove Boat Launch & Picnic Area[a]	Boat ramp and picnic site	173	Rockingham, VT	TransCanada
Pine Street Boat Launch and Portage Trail Take-Out[a]	Boat ramp	170	N. Walpole, NH	TransCanada
Bellows Falls Fish Ladder Visitor Center[a]	Environmental education	169.2	Rockingham, VT	TransCanada
Bellows Falls Dam Portage Put-In[a]	Boat ramp (cartop), and Portage trail	168.5	Walpole, NH	TransCanada

[a] Indicates TransCanada recreation site as noted on the current FERC-approved Exhibit R – Recreation Map.

ski craft) from shore, islands, bridges, other boats, swimmers, or floats. The legal speed of travel on the river therefore depends upon the river's width.

Power boat wakes are one of the key causes of bank erosion on the main stem of the river above in this reach (CRJC, 2008). CRJC (2008) notes that, with the increase in the types of boating traffic and the potential for shoreline erosion resulting from boat wakes, more enforcement of boating laws is needed.

Fishing is a year-round activity on the main stem of the Connecticut River. The tributaries offer coldwater species such as rainbow, brown, and the native brook trout, and the reservoir provides habitat for warmwater species such as perch, pickerel, bass, bullheads, northern pike, and walleye. Downstream of the dam, shad fishing is very popular during the Spring adult migration. Fish passage facilities now pass anadromous fish and resident species. Section 3.6, *Fish and Aquatic Resources*, provides a detailed discussion of anadromous fish in the Connecticut River. New Hampshire fishing licenses or Vermont resident licenses are required for the Connecticut River, and are good for fishing on either bank of the river and all the river's tributaries up to the first bridge.

New Hampshire DES, assisted by EPA, conducted a water quality assessment of the entire river in New Hampshire in 2004. While no bacterial contamination was present during the 5 days of sampling, the state of New Hampshire still considers that CSOs in the wastewater collection systems serving White River Junction and Lebanon, discharging to the White and Mascoma Rivers (upstream of the Project boundary), render the Connecticut River unsafe for swimming from the confluence of the White River to Blow-Me-Down Brook in Cornish just north of the Project. Below Blow-Me-Down Brook to the Bellows Falls dam, the river is considered safe for swimming and other recreation (CRJC, 2008). Section 3.5 includes information on water quality in Project waters.

Land-Based Recreation in the Vicinity of the Project

TransCanada owns 835 acres of land in the Project. Of this, 62 acres are used for plant and related facilities; 86 acres for public outdoor recreational use; 60 acres have been set aside as "natural" lands; and the remaining 627 acres support local agriculture, farming, and wildlife management. The Project exhibit R recreation map is included in attachment 2 to this PAD.

TransCanada has a Fish Ladder Visitor Center at Bellows Falls dam. TransCanada has provided financial support to the Nature Center of Grafton, Vermont, to operate the facility. The Visitor Center offers environmental education displays, and programs, related to the Connecticut River watershed and the river's plants and animals including a public viewing window into the fish ladder.

During the warmer summer months, through-project canoeing is common and canoe only river camping is popular along the Connecticut River Water Trail. Beginning in 1992, the Upper Valley Land Trust with support from the CRJC and TransCanada, created a string of seasonal, primitive canoe campsites along the Connecticut River including some within the Project. Table 3.10-2 shows primitive canoe campsites open to the public. There is no charge for use of the campsites (outside state parks), which are available on a first-come, first-served basis.

Although the campsites are intended for canoe and kayak access from the river only, boaters sometimes use them (CRJC, 2008). TransCanada maintains a 1.5-mile canoe portage trail along the east side of dam.

Table 3.10-2. Connecticut River Water Trail campsites.

Campsite Name	Town	Manager	RM	Capacity	Amenities
Wilgus State Park	Weathersfield, VT	State of VT	191	8 people/ site	Fee for sites
Student Conservation Association	Charlestown, NH	Student Conservation Association	184	2	
Lower Meadow[a]	Charlestown, NH	TransCanada	174	10+	Composting toilet and platforms.

[a] Indicates TransCanada recreation site as noted on the current FERC-approved Exhibit R – Recreation Map.

According to the CRJC Recreation Management Plan (2008) there are few trails close to the river in this area; however, there are a number open to the public nearby, of which the trails up Mount Ascutney in Windsor, West Windsor, and Weathersfield are perhaps best known. Aside from formal trails, New Hampshire's current use law (RSA 79-A), a tax incentive to qualifying landowners that agree to maintain their land in an undeveloped condition, contributes to the aesthetic and recreational values throughout the state because more than half the land in New Hampshire is enrolled in the program. Property owners in the current use program receive additional tax savings under the recreational discount if they keep their land open for public recreation uses and without fee all year for hunting, fishing, snowshoeing, hiking, skiing, and nature observation. Although lands in the current use program can be posted against trespassing, very little actually is (SPACE, 2007).

The Connecticut River's role as a migratory flyway brings an abundance of waterfowl to the river each spring and fall, especially to the shallow waters of "setbacks" at the mouths of tributaries, such as Herrick's Cove (CJRC, 2008). Connecticut River Birding Trail designated observation sites are located in both Vermont and New Hampshire, including Audubon Society recognized important bird areas. Herrick's Cove in Rockingham, Vermont, is the only birding trail stop within the Project.

New Hampshire and Vermont have enacted reciprocal migratory waterfowl hunting rights for licensed waterfowl hunters in the Connecticut River zone; a designated area essentially between Interstate 91 in Vermont and Routes 12 and 12A in New Hampshire. A person holding either a Vermont or a New Hampshire resident hunting license for migratory waterfowl and coots may hunt them in this area subject to the Connecticut River Reciprocal Agreement. It is illegal to use lead shot while hunting migratory waterfowl.

During the winter months, popular recreation activities throughout the Connecticut River Valley include cross-country skiing and skating, snowmobiling, ice skating, and ice fishing on the Connecticut River and nearby shore lands. Snowmobiling and cross-country ski trails crisscross the region, connecting towns and businesses, and distance skaters are known to use the river (CRJC, 2008). Ice fishing is also popular with the seasonal placement of ice fishing shanties on the ice up and down the river.

3.10.3 Recreational Use

New Hampshire residents report that the Connecticut River is the fourth most visited waterbody in the state behind Lake Winnipesaukee, Lake Sunapee, and the Merrimack River (New Hampshire OEP, 2007). TransCanada (2009) estimated the Project received 367,500 recreation-days with a peak weekend average of 7,000 recreation days.

3.10.4 Shoreline Buffer Zones

The Connecticut River is a designated river under the New Hampshire Rivers Management and Protection Program, which has supported the development of Local Advisory committees representing many of the communities along the New Hampshire shoreline along with encouraging local shoreline zoning and development restrictions to protect the river. The New Hampshire Shoreland Water Quality Protection Act (NH RSA 483-B) also regulated shoreline development and use within 250 feet of the river. State law requires a 50-foot building setback and a 150-foot natural shoreland buffer, and in many towns the local zoning is often more protective. Within the protected shoreland, certain activities are restricted or prohibited, and others require a permit from the New Hampshire DES. The Shoreland Water Quality Protection Act addresses all construction and building within this buffer including residences, docks, building setbacks, impermeable surfaces, erosion control during construction projects, and vegetation maintenance. All activities that are regulated by the New Hampshire DES must also comply with applicable local, state, and federal regulations.

While some Vermont towns have local zoning that protects their Connecticut River shoreland, there is no state protection of shorelands in Vermont (CRJC, 1997).

Vermont ANR has issued riparian buffer guidance for Act 250[5] regulated projects, which recommends 100 feet from lakes and ponds and either 50 or 100 feet from rivers and streams. New Hampshire jurisdiction extends to the low water mark on the Vermont side, and in some places the state line has been inundated by the construction of dams.

TransCanada-owned lands within the Project area are managed in accordance with the recreation, cultural, visual, and aesthetic conditions of the current FERC license.

3.10.5 Current and Future Recreation Needs Identified in Management Plans

Management plans that cover recreation resources within the Project vicinity include the New Hampshire and Vermont Statewide Comprehensive Outdoor Recreation Plan's (SCORP), Connecticut River Recreation Management Plan (prepared by the CRJC), and regional plans developed by Upper Valley Lake Sunapee Regional Planning Commission, Southwest Regional Planning Commission, Southern Windsor County Regional Planning Commission, and Windham Regional Commission. The towns of Walpole, New Hampshire, and Rockingham, Vermont, master plans also were reviewed.

New Hampshire SCORP

The 2007 New Hampshire SCORP, among other things, identifies and prioritizes outdoor recreation opportunities and constraints most critical in New Hampshire. The plan lists the following as current recreation-related issues of statewide importance:

- stewardship of natural resource base for outdoor recreation;
- providing different, sometimes competing, recreational opportunities;
- limited financial and human resources to address a range of recreation needs;
- education of recreational users, municipalities, and landowners about responsible behaviour, laws, and liability;

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[5] The Vermont legislature passed Act 250 known as the Land Use and Development Act in 1970. The law created nine District Environmental Commissions to review large-scale development projects using 10 criteria designed to safeguard the environment, community life, and aesthetic character of the state. The Commission has the authority to issue or deny permits for any project that encompasses more than 10 acres or more than 1 acre for towns that do not have permanent zoning and subdivision bylaws. The law also applies to any development project with more than 10 housing units or housing lots and may also apply for construction proposed above 2,500 feet of elevation.

- impacts of existing land use patterns on recreational opportunities; and
- importance of local outdoor recreation opportunities and open space protection in promoting increased health and wellness.

Vermont SCORP

The 2005 Vermont SCORP, among other things, identifies and prioritizes outdoor recreation opportunities and constraints most critical in Vermont. The plan lists the following as current recreation-related issues of statewide importance relevant within the context of the Connecticut River:

- Vermont's natural resource base, which provides the foundation for outdoor recreational pursuits, is conserved and enhanced;
- The majority of private landowners in Vermont continue to allow access to their land for public recreation; and
- Outdoor recreationists in Vermont appreciate nature and the natural resource base and treat private and public resources and other users with respect.

In addition to these general priorities, the Vermont SCORP identifies seven issues directly applicable to water-based recreation throughout the state and not just the Connecticut River, including:

1. Access areas of the Vermont Fish & Wildlife are being used for a variety of activities other than the intended fishing and wildlife-based recreation pursuits;
2. Conflicts among anglers, floaters, landowners, and swimmers, especially during high use periods (hot summer weekends), exist in many areas. These include littering, trash dumping, and inconsiderate behavior;
3. Public access is a top concern for water-based recreational issues;
4. Some existing and improvised access sites have erosion problems;
5. There is a need for legal portage sites where there are obstacles to floaters who have no legal way to portage past them;
6. In some places and instances, water-based recreationists access waters from private property without permission; and
7. Adequate boat speed enforcement is needed.

Upper Valley Lake Sunapee Regional Planning Commission (New Hampshire)

The Upper Valley Lake Sunapee Regional Planning Commission (UVLSRPC) is a public, nonprofit, voluntary association of towns and cities in the Upper Valley and Lake Sunapee areas. Towns served along the Project in New Hampshire include Cornish, Claremont, and Charlestown. UVLSRPC's work includes transportation planning; solid waste planning; organizing and running household hazardous waste collections; working with communities to develop or amend master plans, capital improvement plans, and local land use controls; assisting with the preparation of grant applications; administering grants; using geographic information systems (GIS) for mapping and traffic and land use analysis; environmental and resource planning; and assisting communities with related issues that arise. It is the goal of the UVLSRPC is to assist communities in making land use decisions that best suit their needs. While the Commission has access to resources and expertise in planning principles, communities are best at implementing what works for their unique culture, history and community interests. In July and August 2012, UVLSRPC staff members solicited public input from regional outreach events for inclusion in a regional plan, which is not yet available.

Southwest Regional Planning Commission (New Hampshire)

Within the Project, Walpole, New Hampshire, is the only town served by the Southwest Regional Planning Commission (SWRPC). The SWRPC Regional Plan (2002) addresses 11 topics as warranting attention in community planning and municipal governance including recreation. Specific areas of concern related to recreation resources within the SWRPC area include:

- the displacement of wild places that have traditionally been available to public use (for trails, hunting and fishing, swimming, or nature appreciation) by new housing and roads;
- an aging population will need different sorts of recreation and transportation to reach it; and
- management of recreational facilities under increased use will require an increase in volunteer and fiscal resources.

Southern Windsor County Regional Planning Commission (Vermont)

Towns served along the Project in Vermont include: Windsor, Weathersfield, and Springfield. The Southern Windsor County Regional Planning Commission (SWCRPC) Regional Plan (2009) identifies a number of planning topics; however, recreation is not a specific topic or heading of any of the chapters covered in the plan. The plan does identify recreation-related concerns specifically related to aquatic invasive species (discussed in relation to the Project in section 3.7.3, *Plant and Animal Species*) including the following:

- Recreation opportunities may also be impaired if certain aquatic invasive exotic species such as zebra mussels (*Dreissena polymorpha*) spread to the region. While some aquatic invasive exotic species have not yet reached this region, preventing their spread is essential;
- Eurasian water milfoil is found in the Connecticut River;
- The most recent threat is from Didymo (*Didymosphenia geminate*) also known as “rock snot” which has been found in the Connecticut River. This freshwater diatom produces a fibrous stalk that can

develop into visible mats several inches thick that can carpet a stream bottom resulting in negative ecological, economic and aesthetic impacts in infested areas;

The plan lists two goals under wildlife related to recreation resources;

- Support recreational activities, fishing and hunting done in an ecologically sound manner providing for the continued success of wildlife species and their habitat; and
- Combine recreation and wildlife corridor uses to develop a greenways network in the region.

Windham Regional Commission (Vermont)

Within the Project, Rockingham, Vermont, is the only town served by the Windham Regional Commission. The Windham Regional Plan (2006) identifies a single regional goal:

- To maintain and enhance recreational opportunities for both residents and visitors in keeping with the carrying capacity of natural resources and public facilities.

The plan recognizes that the Windham region is rich in water resources; however, it notes there is a shortage of access to lakes and ponds in the region. The plan notes that 28 lakes and ponds in the region are more than 20 acres; however, only 9 miles of shorelines of these major lakes and ponds are on public or conserved lands.

The plan also states the following policies related to water-based recreation in the region:

- Recognize the recreational potential of watercourses and shorelines and provide facilities for water-oriented day use; and
- Provide separate areas or facilities for conflicting uses of recreational resources. For example, swimmers and motorboats should not compete for the use of the same resource when such conflicts create safety hazards or significantly impair the use or enjoyment of the resource.

Rockingham – Bellows Falls Town Master Plan (2011), Vermont

The town recognizes the importance that the Connecticut River and TransCanada facilities play in serving the residents. The plan specifically mentions TransCanada's boat launch and picnic area at Herrick's Cove. The town notes that, because it was designated an Important Bird Area by the National Audubon Society and Vermont Audubon Council in 2000, passive recreational use should continue, and development of the area for camping trailer use would not be appropriate. The town lists the following recreation-related policies and action steps:

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.
2. Land and water areas of high outdoor recreation potential should be protected from development. Access to such lands should not be restricted.

   Action Step 1: The Select board shall appoint a Recreation Commission with the following responsibilities: to work with TransCanada in assessing maintenance issues at the Herrick's Cove boat launch/picnic grounds.

   Action Step 4: Improve existing and establish new access to local rivers; evaluate the feasibility of creating a pathway from Bellows Falls to Herrick's Cove.

Town of Walpole Master Plan, New Hampshire

The plan was reviewed but there were no recreation needs related to the Connecticut River listed in the plan.

Connecticut River Recreation Management Plan

According to CRJC (2008), adequate public access to the Connecticut River within the Project area for motor boats already exists. There are major public boat ramps located in nearly every town where the river is wide enough to accommodate power boat traffic (Charlestown, Claremont, Springfield, and Rockingham), except for Weathersfield. The CRJC recreation subcommittee believes that adding further access for trailered boats will create additional boating conflicts, contribute to water quality problems, and strain the already limited enforcement ability of the New Hampshire Marine Patrol. The State of New Hampshire generally does not approve permits for boat launches or ramps for private use because the potential for long-term water quality degradation resulting from them is so great. For this reason, and because of limited Marine Patrol presence on the river, the Subcommittee agreed that no further private boat ramps should be approved on the Connecticut River.

Relative to commercial access to the river, the CRJC recreation subcommittee wrote "[t]he river's depth, width, flow, and fluctuating level in this segment are incompatible with development of marinas with conventional docks and gas service on the water." The final recommendation discouraged towns and state agencies from allowing further development or expansion of instream marinas.

The Connecticut River Recreation Management Plan (CRJC, 2008) identified a need for more access for canoes and kayaks, because these craft cannot travel as far and as fast as power craft. There is no public river access in Plainfield or Windsor, where the river is suitable only for very shallow draft boats. The study recommends that the Vermont Department of Fish and Wildlife assist the town of

Windsor in studying and creating appropriate sites for foot and car-top boat access to the river.

Upper Connecticut River Water Trail Strategic Assessment

The Upper Connecticut River Water Trail Strategic Assessment (Pollock, 2009) was funded to build upon previous planning processes that established the Connecticut River Trail. The goals of the study included identifying potential organizations that could develop the Connecticut River Paddlers Trail; better understand the location of existing access and campsites; assess gaps in camping and access sites; and develop guidelines for the establishment of new sites. The assessment made the following characterization of paddling resources within the Bellows Falls reservoir:

The opportunity exists to develop official camping facilities at Hubbard Island, in Charlestown, New Hampshire, which is conserved by the Upper Valley Land Trust and used primarily by the Student Conservation Association (Pollock, 2009).

3.10.6 Specially Designated Lands

Silvio O. Conte National Fish and Wildlife Refuge

Silvio O. Conte National Fish and Wildlife Refuge was established in 1997 to conserve, protect, and enhance the abundance and diversity of native plant, fish, and wildlife species and the ecosystems on which they depend throughout the 7.2 million acre Connecticut River watershed. Legislators made the charge so comprehensive because they realized that, in order to protect migratory fish and other aquatic species, there was a need to protect the whole river system and its watershed; the health of any aquatic ecosystem is linked to the health of the whole watershed upstream. It is one of only three refuges in the National Wildlife Refuge System that has “Fish” in its title (FWS, 2012).

In order to accomplish the purposes of the Conte Act, areas that contribute substantially or in unique ways to protecting the fish, birds, federally listed species, wetlands, and overall biodiversity within the watershed were identified. Land acquisition, a traditional conservation tool, is limited to a few high priority sites or “Special Focus Areas.” As of June 2012, the refuge comprises 35,371 acres extending from northern Vermont and New Hampshire to southern Connecticut (FWS, 2012). The Nulhegan Basin Division in Vermont's Northeast Kingdom accounts for 26,738 acres. There are two divisions in northern New Hampshire (Pondicherry and Blueberry Swamp), three in Massachusetts (Fort River, Mill River, and Westfield River), and one in Connecticut (Salmon River). These divisions account for 34,783 acres or 98 percent of the refuge acreage. All of these areas are outside and considerable distance from the Project.

National Blueways System

In May 2012, Interior designated the 410-mile long Connecticut River as America’s first National Blueway. Within Interior, the Connecticut River (and other to-be designated rivers) will be given priority for conservation and restoration programs the agency administers, such as water conservation and recreation.

National Heritage River Designation

The Connecticut River was locally nominated, and is designated as an American Heritage River under Presidential Executive Order 13061- Federal Support of Community Efforts along American Heritage Rivers (September 11, 1997). This designation encourages natural resource and environmental protection, economic revitalization, and historic and cultural preservation through federal agency support of community-based efforts to preserve, protect, and restore these rivers and their communities.

Connecticut River Byway

Designated a national scenic byway in 2005, the Connecticut River Byway follows the river on both sides throughout New Hampshire and Vermont. More than 500 miles of roads on both sides of the river are included, and encompass the major state roads that border the river as well as several spur routes to scenic areas or special attractions. In the Project area, it follows Routes 5 in Vermont, and Routes 10, and 12A in New Hampshire, visiting the historic villages, scenic river overlooks, and Dartmouth College along the way. Scenic views along the Byway are being inventoried to help towns and conservation organizations prioritize their protection.

Project Lands under Study for Inclusion in National Trails System or Wilderness Area

There are no areas within or in the vicinity of the Project that are included in, or have been designated as, wilderness areas, recommended for such designation, or designated as a wilderness study area under the Wilderness Act.

National Wild and Scenic River System Designation

Under the National Wild and Scenic Rivers System, in January 1980, the Connecticut River from Vernon, Vermont, to Newbury, Vermont, was identified in the recreation rivers study under a preliminary list of rivers under evaluation. However, this reach of the Connecticut River is not free-flowing because of the three hydroelectric projects in this region (Vernon, Bellows Falls and Wilder) and to date no segments of the river within the Project area have been designated under this program.

State-Protected River Segments

The Connecticut River from Fourth Lake to the Massachusetts state line has been designated into the New Hampshire Rivers Management and Protection Program (RMPP) (NH RSA 483). The RMPP provides certain instream flow protection measures for designated rivers and a river classification system to match general river characteristics with the specific protection measures. According to RSA 483:7-a, rivers can be classified as natural, rural, rural-community or community. For each river classification, state law establishes specific protection measures that pertain to structures and activities within the river; these include dams, hydroelectric energy facilities, channel alterations, maintenance of water quality, protected instream flows, inter-basin water transfers, and recreational uses of those river segments classified as “natural.” The non-overlapping segments within the Project are classified as rural, rural-community, and community (New Hampshire DES, 2012). By law, the only land use protection measures that are included with a river designation are those for solid and hazardous waste facilities. Community segments are designated as such in part to recognize and support associated uses including hydropower.

3.10.7 Regionally or Nationally Important Recreation Areas

Both land- and water-based recreation opportunities abound throughout New England. Within a 60 mile radius of the Project (the study area for purposes of this section), there are more than 950 ponds, lakes, or reservoirs (surface water) that have the potential to provide a water-based recreation experience. However, the overwhelming majority of these lakes or ponds are smaller than 100 acres, may not be open to the public, and may not offer identical recreation opportunities or experiences as those available within the Project. There are about 65 lakes, ponds, or reservoirs larger than 250 acres within the study area. Figure 3.10-2 shows the relative location of the Project in the region and potential land- and water-based recreation lands within the 60 mile study area. Table 3.10-3 summarizes the larger bodies of water (more than 250 acres of open water) within this study area that likely provide similar water-based recreation opportunities.

In addition to water-based recreation opportunities, there are numerous local, state, and national forests or parks within the same 60 mile study area. There are thousands of conservation tracts within 60 miles of the Project in New Hampshire, Vermont, and Massachusetts (see figure 3.10-2).[6] There are about 70 state or national parks or forests with some portion of their land area within the 60- mile extent of the study area. Table 3.10-4 summarizes the national, state, and local parks and forests that provide outdoor recreation opportunities within 60 miles of the Project that are larger than two square miles in size (those thought to provide the most important amounts of land in the region). In addition to the lands shown in table 3.10-4, the towns and counties within this area provide an additional 20 square miles of lands for recreation purposes.

[6] Although conservation easements are known to exist in all three states, only Vermont withholds data pertaining to those easements on private lands from non-research based organizations and thus unavailable to publish in this document at the time of printing. Conservation easements are shown in relation to recreation sites in figure 3.10-1.

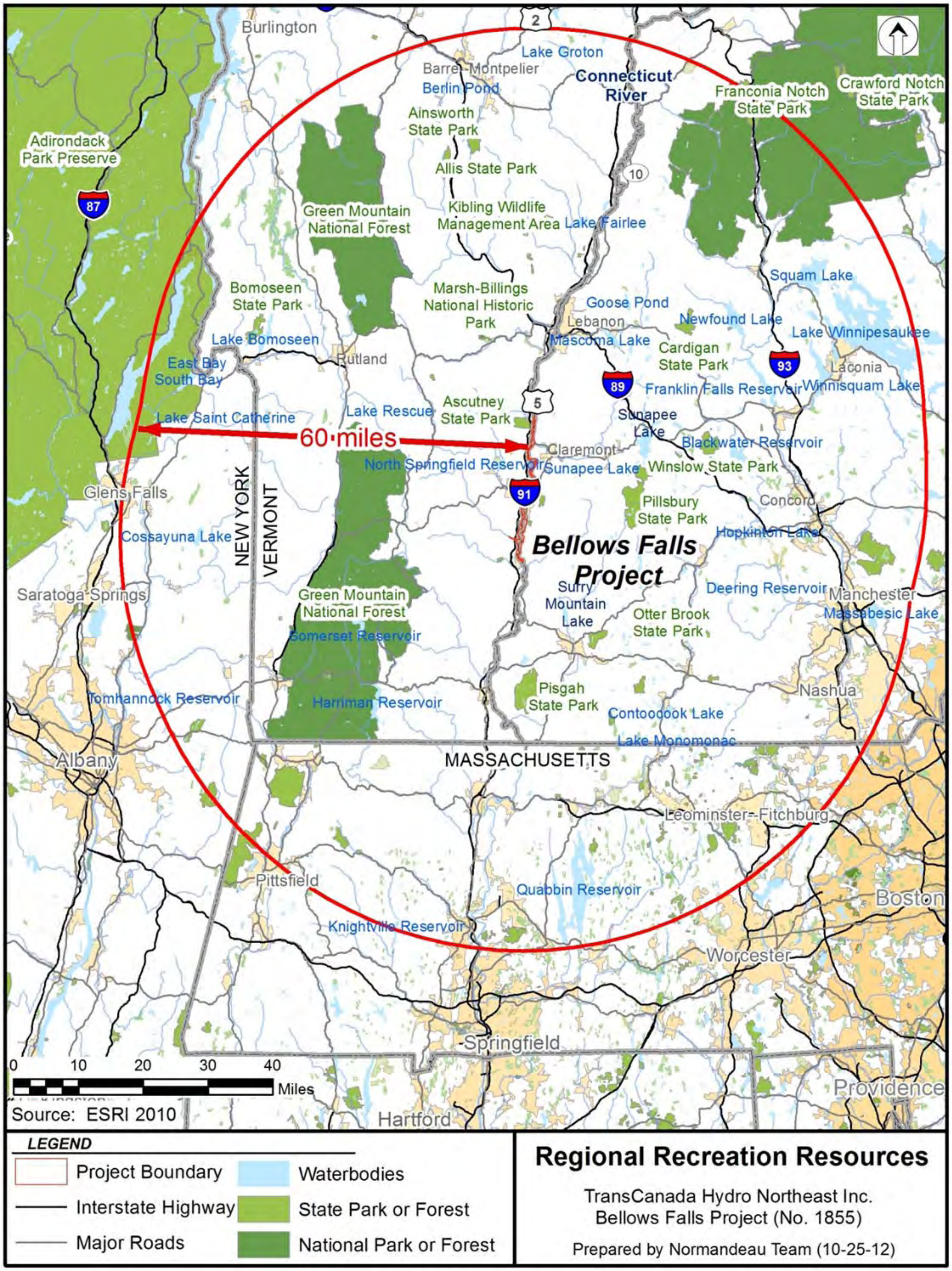

Figure 3.10-2. Project regional recreation sites.

Table 3.10-3. Reservoirs, lakes, and ponds larger than 250 acres and within 60 miles of the Project.

Lake / Pond	Acres
Lake Winnipesaukee[a]	45,850
Squam Lake	6,707
Newfound Lake	4,250
Swamp Pond	4,128
Lake Sunapee	4,064
Bomoseen, Lake	2,330
Harriman Reservoir	2,010
Somerset Reservoir	1,498
Massabesic Lake	1,363
Waukewan, Lake	1,101
Pleasant Lake	1,056
Dunmore, Lake	1,011
Highland Lake	954
Crystal Lake	915
Mascoma Lake	864
Long Pond	845
Saint Catherine, Lake	826
Sunset Lake	800
Spofford Lake	736
Nubanusit Lake	736
Goose Pond	704
Chittenden Reservoir	698
Suncook Lake	691
Mud Pond	691
Cossayuna Lake	634
Northwood Lake	595
Webster Lake	589
Silver Lake	576
Lake Monomonac	570
Morey, Lake	531
Powder Mill Pond	486
Franklin Pierce Lake	486
Little Sunapee Lake	467
Fairlee, Lake	448
Harvey Lake	442
Little Squam Lake	435
Mirror Lake	410
Massasecum, Lake	390
Groton Pond	384
Penacook Lake	365
Kanasatka, Lake	365
Stinson Lake	339
Little Turkey Pond	339
Grafton Pond	339
Lake Tarleton	333
Contoocook Lake	333
Weare Reservoir	326
Glen Lake	326
Eastman Pond	320
Deering Reservoir	314
White Oak Pond	307
Upper Naukeag Lake	301
Spectacle Pond	301
Hickory Hills Lake	294
Halfmoon Lake	288
Loon Pond	288
Mare Meadow Reservoir	288
Canaan Street Lake	288
Berlin Pond	288
Pleasant Pond	282
Lower Naukeag Lake	269
Quinapoxet Reservoir	262
Pemingewasset Lake	256
Jenness Pond	256
Thorndike Pond	250

[a] Limited portion within 60 mile radius of Project.

Table 3.10-4. National, state, or local parks or forests larger than 2 square miles and within 60 miles of the Project.

Name	Square Miles
National Park or Forest	
White Mountain National Forest	1,260.3
Green Mountain National Forest	974.4
Saratoga National Historic Park	4.3
State Park or Forest	
Adirondack Park Preserve[a]	8,845.9
Mount Greylock State Park	24.0
Balance Rock State Park	22.7
Bear Brook State Park	20.6
Pisgah State Park	19.8
Franconia Notch State Park	10.1
Pillsbury State Park	8.3
Pillsbury State Forest	8.2
Winslow State Park	6.7
Leominster State Forest	6.4
Cherry Plain State Park	6.1
Bomoseen State Park	5.6
Townsend State Forest	5.3
Holyoke Range State Park	5.2
Cardigan State Park	5.0
Otter Brook State Park	4.5
Ainsworth State Park	3.8
Ascutney State Park	3.8
Mount Sunapee State Park	3.7
Grafton Lakes State Park	3.7
Windsor James State Park	3.4
Allis State Park	3.3
Willard Brook State Forest	3.2
Wachusett Mountain State Reservation	3.0
Monadnock State Forest	2.7
Ashburnham State Forest	2.5
Rutland State Park	2.2
Ware River Watershed System	2.0
Local and County Park	
Bearsden Forest Conservation Area	3.3
Pelham Lake Park	3.1
Roadside Park	2.4
Kibling Wildlife Management Area	2.6

[a] Limited portion within 60 mile radius of Project.

3.10.8 Non-recreational Land Use and Management within the Project Boundary

TransCanada holds fee ownership of 835 acres of land in the Project. These holdings are dispersed along the reservoir and comprise river setbacks, flood plains, marsh areas, large open pasture lands, abandoned farm lands, and moderately forested undeveloped lands.

Project operations and maintenance are the primary non-recreational activities that occur within Project lands. Maintenance activities include road maintenance, vegetation/debris clearing and snow removal. In compliance with the existing Project license, TransCanada has also granted permission to others for the use of Project lands. These permitted uses include agricultural licenses, and easements for roads, bridges and utilities, roads, bridges, telephone, and electrical transmission lines. All docks are associated with the private lands that abut the Project but are not on Project land. They are relatively few and have not required a formal permitting process or management.

3.10.9 Recreational and Non-recreational Land Use and Management Adjacent to the Project Boundary

Land-based recreation not associated or dependent on the river located adjacent to the Project boundary is provided by the states of Vermont and New Hampshire (e.g., state parks, wildlife management areas, visitor centers), neighboring towns (park facilities in Charlestown and Walpole, New Hampshire, including ball fields, picnic areas, horseshoe pits, and vehicle parking) and private businesses (marina).

The Fort at Number 4 is a living history museum, recreated to depict its appearance during King George's War. The Fort is located adjacent to Patch Park, a Town of Charlestown municipal park. During most summers, the fort hosts both French and Indian War and American Revolutionary War reenactments. A group of historians and enthusiasts portray the settlers and town militia.

Bellows Falls Historical Society owns and maintains about 7 acres of land, including historic mill buildings, adjacent to the Connecticut River in Bellows Falls in proximity to the dam. The Society operates the Grist Mill Museum adjacent to the powerhouse area.

The Bellows Falls reservoir extends more than 26 miles from Bellows Falls dam in a classically New England pastoral setting. Bottomland agriculture is the dominant land use in the project area, and prime agricultural soils in the corridor are believed by some to be the best agricultural soils in either state (CRJC, 1997). The agriculture is a mix of dairy, vegetable, and hay farming operations. Most residential housing in the corridor is single-family homes.

Figure 3.7-2 shows generalized land cover types for lands in the Connecticut River Valley in the Project area. Higher density development, including commercial/industrial development, occurs primarily in Ascutney and Rockingham on the Vermont side and Charlestown on the New Hampshire side. Development associated with the village of Bellows Falls in Vermont and North Walpole in New Hampshire surrounds Bellows Falls dam because the dam and historic mill were the driving economic force in the area when it was first constructed. See section 3.13, *Socioeconomics*, for further information about economic development in the Project area.

3.10.10 Project Effects

The Project provides multiple water-oriented recreation resources to the towns and communities along its shoreline. In addition to the public access points, local businesses dedicated to supplying additional recreation-related services and goods (e.g., marinas, overnight lodging and camping, outfitters, downriver float trips, tackle shops) are established in the area providing additional value to the recreation resources. The project is a year-round recreation destination for camping, boating, hiking, bird watching, fishing, and snow and ice sports. TransCanada's current exhibit R recreation maps (part of the existing FERC license) identify public access areas and open space within Bellows Falls impoundment and downstream of Bellows Falls dam in the Project boundary.

Flows in this section depend upon tributary inflow contribution and operations at the upstream Wilder dam and at Bellows Falls dam, and the river may be shallow in some places in times of low flow. Instream anglers and boaters must be aware of the potential for water releases from the dams because they may result in either gradual or sudden changes in water level and current depending on reach. TransCanada's current Public Safety Plan identifies signs, lights, and sirens used to warn the public before changes in operations at the Project. Inherently, due to upstream seasonal storage, flows through the project during typical low flow periods are higher than what they would be in a natural system and as a result there are numerous recreational benefits that result.

During weekends and on holidays from Memorial Day through the beginning of October the water level in the reservoir is kept at 289.6 feet from 4 pm Friday to midnight Sunday. TransCanada may on rare occasions draw down water levels during this period to accommodate dam-related construction projects, or upon request of the states, towns or railroads for such projects as bridge abutment or rail line infrastructure construction or maintenance.

Water level fluctuations in front of and downstream of Bellows Falls dam make it unsafe and impractical for consistent use of these areas for winter ice-based recreation activities like ice skating, ice fishing, snowmobiling, and cross-country skiing.

TransCanada does not propose any changes to the existing Project. Therefore there would be no incremental negative effects on recreation resources associated with the Project as proposed.

Both Project and non-project public and private recreational development appear to satisfy present demand. The Project supports long-distance, scenic river corridor experiences in part due to the private and project rural and agricultural land use that abuts the impoundment. In addition, railroad tracks that parallel the river also limit shoreline encroachment and development. Collectively, these factors have resulted in long impoundment reaches that support high-value, in-stream opportunities that are unique. This aligns closely with recreational goals outlined in the various regional and statewide plans. Due to the largely undeveloped nature of the lands within and adjacent to project boundary, which are largely private land with flowage easement retained; shoreline protection laws; local zoning and the lack of over-demand or use conflicts, there does not appear to be sufficient need for a shoreline management plan for this Project.

TransCanada does not propose any changes to the existing Project. Therefore there would be no incremental negative effects on recreation resources associated with the Project as proposed.

3.10.11 References

CRJC. 2008. Connecticut River Corridor Management Plan, Wantastiquet Region. Charlestown, NH. Available online at: http://www.crjc.org/new%20WR5%20chapter/WATER.LRS5.final.pdf.

CRJC. 1997. Connecticut River Corridor Management Plan. Summary of the Wantastiquet Region Subcommittee Plan. Charlestown, NH.

FWS (U.S. Fish and Wildlife Service). 2012. Silvio O. Conte National Fish and Wildlife Refuge, Northeast Region Web Site. Available at: http://www.fws.gov/r5soc/ (accessed on August 28, 2012).

New Hampshire DES. 2012. Watershed Management Bureau, Designated Rivers Map. March 2012. Available on the web at: http://des.nh.gov/organization/divisions/water/wmb/rivers/documents/designated_rivers.pdf accessed on August 28, 2012.

New Hampshire OEP (Office of Energy and Planning). 2007. New Hampshire Statewide Comprehensive Outdoor Recreation Plan (SCORP): 2008-2013. Concord, New Hampshire. December 2007.

Pollock, N. 2009. Vermont River Conservancy: Upper Connecticut Paddlers Trail Strategic Assessment. Pollock, Noah. Updated May 12, 2009.

SPACE (Statewide Program of Action to Conserve Our Environment). 2007. A Layperson's Guide to New Hampshire Current Use. Available at: http://www.nhspace.org/downloads/SPACE_Laypersons_Guide_07.pdf. (accessed on October 10, 2012).

3.11 AESTHETIC RESOURCES

3.11.1 Summary of Existing Studies

There are numerous existing management plans and policy documents that address the Connecticut River Valley in the Project vicinity. This section reviews those resources and places them within the context of existing aesthetic resources. TransCanada has defined the Project affected area for aesthetics as Bellows Falls reservoir within the Project boundary including about a half mile downstream of the dam.

The following sources of information were used to describe the aesthetics resources of the Project area:

- Bellows Falls Exhibit R Maps;
- CRJC Connecticut River Corridor Management Plan; Recreation Plan; Water Resources Plan, and Boating on the Connecticut River Maps;
- New Hampshire and Vermont SCORPs;
- Regional planning documents, including management plans from: Windham Regional Commission; Southern Windsor County Regional Planning Commission; Upper Valley Lake Sunapee Regional Planning Commission; and the Southwest Region Planning Commission;
- Rockingham and Walpole Town Plans;
- FERC Licensed Hydropower Development Recreation Report – Form 80s;
- New Hampshire Walleye Creel Survey Data; and
- And aerial photos, topographical maps, USGS maps, Connecticut River Paddler Trail map info, and Google Earth.

3.11.2 Visual Characteristics

The Connecticut River Valley is bounded by the Green Mountains in Vermont and the White Mountains in New Hampshire. The U.S. Department of Transportation, Federal Highway Administration, recognizes the Valley for its scenery, and designated a distinct collection of roads and waypoint communities as a national scenic byway. Land use along the corridor of the Connecticut River is primarily rural and agricultural, with considerable land forested and undeveloped. A majority of the land along both sides of the river is zoned for limited residential use (New Hampshire DES, 2008). There are infrequent commercial and industrial sites and, in general, existing developments are well-screened from the river (New Hampshire DES, 2008). Figures 3.11-1 and 3.11-2 provide examples of the visual character of the Project.

Figure 3.11-1. View North from Pine Street Boat Launch and Picnic Area.

Figure 3.11-2. Bellows Falls reservoir near Hoyts Landing.

The settlement patterns of Europeans in the Connecticut River Valley developed a mosaic of villages and small cities surrounded by rural areas, and this pattern persists in many areas today. This pattern of development is characteristic of the Valley and lends to its appeal for both visitors and residents (New Hampshire DES, 1997). Town squares with white houses and churches, stately brick homes, and rows of brick mill buildings provide a historic architectural heritage of outstanding quality (New Hampshire DES, 1997).

The Connecticut River and its valley provide some of the most valuable scenic views within Vermont and New Hampshire. The river provides views of long stretches of whitewater, surrounding wetlands full of wildlife, views from the river of distant peaks, town hall steeples, vast agricultural fields and farmlands, and traditional New England homes such as those in North Walpole and the Village of Bellows Falls. The mix of open space, villages, farms, country roads, mountainous terrain, historic architecture, and surface waters in the area provide for scenic vistas and an attractive landscape. Route 5 in Vermont and Route 12/12A in New Hampshire from Bellows Falls/North Walpole to Ascutney/Windsor parallels the river and are part of the Scenic Byway. Agricultural fields and working forestlands juxtaposed to dense villages combine to create the traditional New England landscape that residents and tourists cherish. The Project is located in the fertile soils of the Connecticut River Valley; as such much of the surrounding land use is agricultural and forested areas. Other land use types include: rural residential areas, commercial, industrial, and transportation developments, and wetlands. Railroad tracks are commonly found along the banks on both sides of the river and in proximity to the Project, particularly where the river is close to more developed areas such as within Bellows Falls, Vermont.

The Project is located among the exposed rocky gorge and in the Village of Bellows Falls historic district. The Project was developed to capitalize on the notable drop in the river in this section, after which the village of Bellows Falls is named. The historic mill used the drop in the river for water power to run the mill. The commercial district developed around the mill and along Canal Street, which provides the water to the Bellows Falls power house, all of which are part of the Bellows Falls historic district. Given the Project's location and age, it is a prominent feature in the town with historic mill buildings adjacent to the canal and the Project works themselves. The Bellows Falls Visitor/Environmental Education Center invites the public to the facility, enhancing education opportunities within the historic district.

The steep rocky hillsides surrounding the Project are heavily wooded with mixed hardwood interspersed with conifers. Species of hardwood trees include red maple, sugar maple, red oak and white ash; as well as paper birch, yellow birch and black cherry, which all provide stunning color during fall foliage. Conifer species are made up primarily of Eastern white pine and Canadian hemlock.

The town of Rockingham identified scenic resources in its latest town plan (2011). Scenic resources shown on the Town of Rockingham scenic and recreational resources maps related to views of the Bellows Falls Project focus on views of the Connecticut River, and include:

- S-5. View northerly of the Connecticut River from the junction of Rockingham and Atkinson Streets Bellows Falls Village
- S-6 Scenic View of Connecticut River Valley southerly from Interstate 91 near former rest area on Rockingham/Springfield town line
- S-7. Setback area of the Connecticut River just north of Bellows Falls Located east of Route 5.
- S-8. Herrick's Cove area at confluence of the Williams and Connecticut Rivers
- S-9. Roundy's Cove area located east of Route 5 about two miles north of Herrick's Cove Road
- S-10. Albee's Cove area located east of the railroad causeway along the Setback.
- S-11. View of the Connecticut River from the plateau north of the Williams River.

3.11.3 Project Effects

The river is a significant landform and integral part of the history of the towns along the river including the village of Bellows Falls. Operation of the Project is visible from numerous points around it. Agricultural use of Project lands maintains the pastoral, agricultural character of the greater Connecticut River Valley. These types of uses and the resulting visual character are marketed throughout the region to stimulate tourism within the valley.

The normal operating range of the Bellows Falls Project is 1.8 feet as described in section 2.5, *Current Project Operations.* The primary impact of operations is the amount of shoreline that is visible as the Project stores and releases water for generation needs. TransCanada mitigates these impacts by voluntarily holding the reservoir level at a normal pool elevation of 289.6 feet from Friday at 4 pm through Sunday at midnight and on holidays during the summer recreation season (May 21 – September 16). TransCanada also provides a continuous minimum flow of 1,083 cfs. During high flow periods, the Project uses what it can for generation and passes all the water as it is received. Water is diverted through the bypassed reach resulting in turbulent whitewater and falls through the rocky gorge between the dam and the powerhouse.

Overall, the reservoir is aesthetically pleasing to view throughout the Connecticut River Valley. Acute aesthetic impacts associated with operations are limited to a narrow band of exposed bank associated with reservoir drawdown. Within the context of the larger exposed banks caused by erosion during high flow events the band is considered small. Exposed mudflats and shoal areas surrounding tributaries in the more downstream portions of the impoundment are the result of river profile operations necessary to contain high flows within the banks of the river upstream. Changes in the amount of exposed shoreline are most noticeable where the river bank slopes are gentle. This type of shoreline highlights the visual contrasts of changing reservoir elevations as compared to steep or armored shorelines as the changes expose the native soils between the vegetation at the high water mark and a drawn down reservoir. Given the size of the Connecticut River and its prominence within the greater landscape setting, a less than 2-foot change in reservoir elevation is a modest change and likely to be barely perceptible to the majority of observers in the vicinity of the Bellows Falls Project.

TransCanada does not propose any changes to the existing project. Therefore there would be no effects on aesthetic resources associated with the project as proposed.

3.11.4 References

New Hampshire DES. 2008. New Hampshire Rivers Management and Protection Program, Connecticut River Report to the General Court.

New Hampshire DES. 1997. New Hampshire Rivers Management and Protection Program, River Nomination Form, Connecticut River. July 15, 1991.

Southern Windsor County RPC (Regional Planning Commission). 2009. 2009 SWCRPC Regional Plan. http://swcrpc.org/wp/wp-content/uploads/2011/08/2009-SWCRPC-Regional-Plan.pdf. (accessed October 15, 2012).

3.12 CULTURAL RESOURCES

3.12.1 Discovery Measures

Under the NHPA and its implementing regulations found at 36 C.F.R. § 800(m), the term “historic properties” is applied to any prehistoric or historic district, site, building, structure, object, or Traditional Cultural Property (TCP) included in, or eligible for inclusion in, the National Register of Historic Places (National Register) (Parker and King, 1998; 36 C.F.R. § 800.16(l)). TCPs are defined as those properties that are eligible for inclusion in the National Register because of their “association with cultural practices or beliefs of a living community that are (a) rooted in that community’s history, and (b) are important in maintaining the continuing cultural identity of the community” (Parker and King, 1998). For purposes of this PAD, the term “cultural resources” applies to any prehistoric or historic district, site, building, structure, or TCP regardless of the resource’s individual National Register eligibility.

Phase IA Archaeological Reconnaissance Survey

Section 106 of the NHPA requires the determination of a project’s area of potential effects (APE) in consultation with the appropriate State Historic Preservation Offices (SHPOs). According to the implementing regulations of the NHPA, the APE is defined as “the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties if such properties exist” (36 C.F.R. § 800.16(d)). The APE directly relates to the area to be studied for cultural resources. TransCanada consulted with the Vermont and New Hampshire SHPOs prior to conducting fieldwork and identified an APE for the Project defined as the lands within the FERC license boundary that are owned in fee simple and the river channel and shoreline to the flow line elevation at the 385.0 foot contour line encompassing all land necessary for the operation and maintenance of the Project.

TransCanada conducted a Phase IA archaeological survey to identify known archaeological sites within the Project APE and identify additional areas of archaeological sensitivity where documented and previously unrecorded sites are likely to exist (Hubbard et al., 2012). The Phase IA archaeological survey report will be submitted to the Vermont and New Hampshire SHPOs for review and comment.

As part of the Phase IA archaeological study, site file records and cultural resource management reports housed at the Vermont Division for Historic Preservation DHP) and the New Hampshire Division of Historical Resources (New Hampshire DHR) were reviewed to collect information about and inventory previously recorded archaeological sites within and adjacent to the Project APE. The *Journal of the Vermont Archaeological Society* and the *New Hampshire Archeologist* were reviewed to develop cultural contexts for the project area and to obtain other information pertinent to the Connecticut River Valley

Historic maps and atlases of towns in the Project vicinity were also inspected to assess changes in land use, document structures, and track the development of transportation networks in the vicinity of the Project area. As cited in the Phase IA report (Hubbard et al., 2012), historic maps pertinent to the Project in Vermont included McClellan (1856) and Beers atlases of Windham County and Windsor Counties (Beers, 1869a; 1969b), and the Walling (1860a) map of the State of Vermont. Historical town maps reviewed for the New Hampshire portion of the Project include the Fagan (1858) map of Cheshire County, the Walling (1860b) map of Sullivan County, and the Hurd (1892) town and city atlas of the State of New Hampshire. Late nineteenth through mid-twentieth-century USGS topographic maps were also reviewed.

Historic photographs were also inspected. Photographs of Bellows Falls, Vermont, included images of the Project fee-owned lands and Connecticut River shoreline before and after the construction of the Bellows Falls powerhouse and dam. These photographs were found within the New England Power Company archival photograph collection, which is currently maintained by TransCanada. Also reviewed were images found on the University of Vermont's Landscape Change Project website. This site contains more than 1,000 images of places in Vermont.

Previous geologic studies undertaken by the U.S. Department of Agriculture (USDA) provided information about soil types, surface deposits, and flora and fauna found along the river (USDA, 1987, 1989, and 2011, as cited by Hubbard et al., 2011). Additionally, information about erosion was obtained from the *Lower Connecticut River Shoreline Survey Report – 2010: Bellows Falls Project (FERC No. 1855), Wilder, Project (FERC No. 1892), Vernon Project (FERC No. 1904)* (Kleinschmidt, 2011).

Since the late 1980s, at least seven previous cultural resource investigations have occurred within, or adjacent to, the Project APE. Cultural resources reports that were reviewed included:

- *Archaeological Resources Assessment, Bellows Falls Hydroelectric Development, GSU Switchyard, Bellows Falls, Vermont* (Cherau, 2007a, as cited by Hubbard et al., 2012)
- *Archaeological Resources Assessment, Bellows Falls Substation Revitalization Project, Bellows Falls, Vermont* (Cherau, 2007b, as cited by Hubbard et al., 2012);
- *Phase IB Archaeological Survey G-33 Line Reconductoring and Refurbishment Project, Vermont Portion, Rockingham, Westminster, Putney, Dummerston, Brattleboro, Vermont* (Cherau and Laskoski, 2010, as cited by Hubbard et al., 2012);
- *National Register of Historic Places Registration Form for the Bellows Falls Historic District* (Henry, 1981 as cited by Hubbard et al., 2012);
- *Cultural Resources Assessment, National Grid Bellows Falls Revitalization Project, Activities Related to Access Roads and Laydown, Bellows Falls, Vermont* (Olausen and Cherau, 2011);
- *Archaeology, History and Architectural History of Bellows Falls Island, Rockingham, Vermont* (Mulholland et al., 1988a, as cited by Hubbard et al., 2012); and

- *National Register of Historic Places Inventory-Nomination Form: Bellows Falls Island Multiple Resource Area* (Mulholland et al., 1988b).

The Vermont Department of Historic Preservation *Environmental Predictive Model for Locating Pre-contact Habitation Archaeological Sites* (Vermont DHP, 2002) was applied to the Project APE and indicated that the entire Project APE is generally sensitive for pre-contact habitation sites. The majority of the lands in the Project APE are private lands. These are identified in the Phase IA report as "flowage" lands because TransCanada only has flowage rights necessary for the operation of the Wilder Project. TransCanada does not own the land and therefore has no access rights.

For the purposes of the Phase IA archeological survey, the entire Connecticut River shoreline within the FERC licensed boundary of the Project was subject to a visual inspection by boat. Closer pedestrian inspection was conducted (1) when known sites were recorded in the area and/or cultural deposits/features were observed from the boat using binoculars; (2) in heightened high archaeological sensitivity areas based on established criteria; and (3) where erosional surfaces were present and could not be adequately observed by boat. In some cases where soil strata indicated the potential for cultural deposits, the closer, land-based inspections included minor trowel scraping to confirm the nature and type of cultural materials present. No cultural materials were collected without property owner consent. Other lands within the Project APE are owned in fee by TransCanada. These lands were inspected through a formal pedestrian survey. A survey of visible historic site locations was also undertaken utilizing the same methods with particular attention paid to locations of post-contact period sites that had been noted on nineteenth-century town maps and/or discussed in town histories. Additionally, the Project shoreline and fee-owned lands were stratified into zones of potential or expected archaeological sensitivity to guide future land management and planning activities; these sensitive areas were demarcated on topographic maps.

All identified sites were photographed and those on the shoreline or on fee-owned lands were surveyed using GPS.

Finally, in 1998-1999, PAL completed a study to identify historic standing structures within the Deerfield and Connecticut River hydroelectric systems (Doherty and Kierstead, 1999, as cited by Hubbard et al., 2012). The purpose of this study was to establish a baseline archival record of information for all of the hydroelectric developments along the rivers then owned by TransCanada's predecessor and record baseline conditions. The documentation was completed in accordance with the standards of the National Park Service's Historical American Engineering Record (HAER) program and Vermont, New Hampshire, and Massachusetts documentation standards.

3.12.2 Cultural, Historical, and Archaeological Resources

Archaeological and Historic-era Resources

The Phase IA archaeological reconnaissance survey completed for the Project (Hubbard et al., 2012) identified 16 archaeological sites on private flowage lands, eight sites on fee-owned lands and adjacent private flowage, and two sites on fee-owned lands in Vermont and six archaeological sites on private flowage lands, five sites on fee-owned lands and adjacent private flowage, and six sites on fee-owned lands in New Hampshire, for a total of 43 identified archaeological sites in the Project APE. Table 3.12-1 summarizes these sites. A total of 33 of the resources are exclusively from the pre-contact period, two sites contain both pre-contact and historic components, and eight sites are exclusively from the historic period. The pre-contact period resources range from stratified sites containing distinct hearth features, burials, and living floors to sparse lithic or tool scatters. Other pre-contact sites consist solely of reddened earth or fire-cracked rock indicative of possible hearth features. A single site also contains elaborate petroglyphs. This site is also located within the Bellows Falls Island Multiple Resource Area (Bellows Falls Island MRA), a National Register-listed property. The historic period resources include a historic trash scatter, foundation features, railroad features, abutment features, and other features. One of these historic resources may also be a contributor to the Bellows Falls Island MRA (see below).

Archival research using eighteenth, nineteenth, and twentieth century town and atlas maps and town historical sources identified 26 locations that might constitute additional archaeological sites. Twelve of these locations were in Vermont and 14 were in New Hampshire. Three of these locations in New Hampshire (CH-4, CH-5, WA-1) and one in Vermont (SP-4) are believed to correlate with known archaeological sites. Three additional locations in New Hampshire may also correlate with archaeological sites (CH-1, CH-2, CH-3). The remaining 19 locations were not identified during the Phase IA survey.

Table 3.12-1. Summary of documented pre-contact and historic resources located within or directly adjacent to the project APE.

State Site Number	Project Vicinity	Site Type[a]	Brief Description[b]	Temporal / Cultural Affiliation	Location Relative to the Project	National Register Eligibility
27-CH-169 (new)	Walpole, NH	H	Evidence of old rail beds, concrete foundations, and stored railroad equipment (e.g., ties, track)	Euro-American (late 19th?/early-mid 20th century)	Fee-owned	Undetermined
27-CH-170 (new)	Walpole, NH	H	Historic trash dump with glass, ceramics, and an abundance of coal ash	Euro-American (early to mid-20th Century	Flowage	Undetermined
27-SU-4	Charlestown, NH	PH	Previously recorded as two culturally unaffiliated human burials, stone drill, scraper, and projectile point. Also two historic cellar holes.*	Pre-contact (unknown); Euro-American	Flowage	Undetermined
27-SU-5	Claremont, NH	P	Previously recorded as stratified site with seven identified occupation levels, 150+ hearths, one human burial, numerous lithic artifacts and pottery.*	Pre-contact (Late Archaic, Middle and Late Woodland)	Flowage	Listed

State Site Number	Project Vicinity	Site Type[a]	Brief Description[b]	Temporal / Cultural Affiliation	Location Relative to the Project	National Register Eligibility
27-SU-7	Charlestown, NH	P	Previously recorded as four hearths, a possible living surface (65m long), fire-cracked rock, pottery, calcined bone, chipping debris*	Pre-contact (Woodland)	Flowage	Undetermined
27-SU-12	Charlestown, NH	P	Previously recorded as six pieces of chipping debris*	Pre-contact (unknown)	Flowage	Undetermined
27-SU-16	Claremont, NH	P	Previously recorded as low density of quartz chipping debris on the surface*	Pre-contact (unknown)	Flowage	Undetermined
27-SU-34	Charlestown, NH	H	A square earthen structure or possible military gun emplacement	Euro-American (possibly 18th Century)	Fee-owned	Undetermined
27-SU-35	Charleston, NH	H	A square earthen "foundation"	Euro-American (unknown)	Fee-owned	Undetermined
27-SU-41	Charlestown, NH	P	Previously recorded as quartz chipping debris and cores, a chert flake, hammerstone, projectile point,	Pre-contact (unknown)	Fee-owned	Eligible

State Site Number	Project Vicinity	Site Type[a]	Brief Description[b]	Temporal / Cultural Affiliation	Location Relative to the Project	National Register Eligibility
			calcined bone, fire-altered rock, possible hearth feature*			
27-SU-43 (new)	Charlestown, NH	P	Hearth feature with reddened soils and abundant charcoal	Pre-contact (unknown)	Fee-owned/flowage	Undetermined
27-SU-44 (new)	Charlestown, NH	P	Burn layer with one piece of fire-cracked rock	Pre-contact (unknown)	Fee-owned/flowage	Undetermined
27-SU-45 (new)	Charlestown, NH	P	Burn layer with 57 fragments of fire-cracked rock	Pre-contact (unknown)	Fee-owned/flowage	Undetermined
27-SU-46 (new)	Charlestown, NH	H	Dry-laid farmhouse foundation and associated farm equipment	Euro-American (late 19th to early 20th century)	Fee-owned	Undetermined
27-SU-47 (new)	Charlestown, NH	P	On piece of rhyolite chipping debris	Pre-contact (unknown)	Fee-owned/flowage	Undetermined
27-SU-48 (new)	Charlestown, NH	P	Three burn features with reddened soils, charcoal, and an unmodified shistose	Pre-contact (unknown)	Fee-owned/flowage	Undetermined

State Site Number	Project Vicinity	Site Type[a]	Brief Description[b]	Temporal / Cultural Affiliation	Location Relative to the Project	National Register Eligibility
			manuport			
27-SU-49 (new)	Charlestown, NH	H	Well-constructed dry-laid stone wall, apparently structural, and an oversized groundwater well. Function unknown, but interpreted as a possible trout farm	Euro-American (mid/late 19th century)	Fee-owned	Undetermined
VT-WD-8	Rockingham, VT	P	Numerous aboriginal face petroglyphs arranged into two clusters	Pre-contact (unknown)	Fee-owned	Listed (contributing element of the Bellows Falls Island Multiple Resource Area (Mulholland 1988)
VT-WD-23	Rockingham, VT	P	Previously recorded as a groundstone celt*	Pre-contact (Woodland)	Flowage	Undetermined
VT-WD-76	Springfield, VT	H	Exterior brick wall and large outflow pipe associated with documented pulp mill (circa 1995/1991)	Euro-American (late 19th Century)	Fee-owned	Undetermined (possible contributing element of the Bellows Falls Island Multiple Resource Area)

State Site Number	Project Vicinity	Site Type[a]	Brief Description[b]	Temporal / Cultural Affiliation	Location Relative to the Project	National Register Eligibility
VT-WD-291 (new)	Rockingham, VT	P	Three fragments of fire-cracked rock	Pre-contact (unknown)	Fee-owned/flowage	Undetermined
VT-WN-38	Springfield, VT	P	Previously recorded as fourteen large cache blades, one human burial, chipping debris, groundstone adze and pestle-shaped object, pottery, scraper, and point fragments*	Pre-contact (Middle Woodland)	Fee-owned/flowage	Undetermined
VT-WN-39	Weathersfield, VT	P	Previously recorded as two "fish spears" and numerous other artifacts*	Pre-contact (unknown)	Flowage	Undetermined
VT-WN-41	Springfield, VT	P	Previously recorded as a stratified village site, many features (living surfaces, hearths, storage pits), two human burials, early evidence of agriculture, many artifacts*	Pre-contact (Late Archaic to Woodland)	Fee-owned/flowage	Listed
VT-WN-45	Springfield, VT	P	Previously recorded as three hearths, projectile points, bifaces, grinding	Pre-contact (Late Archaic to Woodland)	Flowage	Undetermined

State Site Number	Project Vicinity	Site Type[a]	Brief Description[b]	Temporal / Cultural Affiliation	Location Relative to the Project	National Register Eligibility
			stone, scraper, chipping debris (2000+), pottery*			
VT-WN-46	Springfield, VT	P	One to two hearth features, fire-cracked rock, pottery, chipping debris, projectile points, "pitted stones"	Pre-contact (Middle to Late Woodland)	Fee-owned/flowage	Undetermined
VT-WN-47	Springfield, VT	P	Previously recorded as unidentified Native American artifacts found based on informant interview*	Pre-contact (unknown)	Flowage	Undetermined
VT-WN-49	Springfield, VT	P	Previously identified as three alleged human burials and 30 stone artifacts*	Pre-contact (unknown)	Flowage	Undetermined
VT-WN-61	Springfield, VT	P	Previously recorded as two hearths, chipping debris, fire-cracked rock, potter, calcined bone, charred nutshells*	Pre-contact (Woodland)	Flowage	Eligible
VT-WN-102	Springfield, VT	P	Previously recorded as five hearths, fire-cracked rock, potter, chipping debris, burnt butternut shells,	Pre-contact (unknown)	Fee-owned/flowage	Undetermined

State Site Number	Project Vicinity	Site Type[a]	Brief Description[b]	Temporal/ Cultural Affiliation	Location Relative to the Project	National Register Eligibility
			calcined bone*			
VT-WN-103	Springfield, VT	P	Previously recorded as three hearths, fire-cracked rock, pottery, calcined bone, chipping debris, shell*	Pre-contact (unknown)	Flowage	Undetermined
VT-WN-186	Windsor, VT	P	Multiple features (living surfaces/hearths, chipping debris, fire-cracked rock, calcined bone, shell, burnt maize, one human burial (relocated)	Pre-contact (Woodland)	Flowage	Eligible
VT-WN-187	Springfield, VT	PH	*Pre-contact*: Previously recorded as one projectile point, pestle, anvil stones, chipping debris, pottery.* *Historic*: Previously recorded as nails, ceramics, and glass, possibly associated with the 18th Century blockhouse nearby*	Pre-contact (Middle Woodland); Euro-American (early-18th Century)	Fee-owned/flowage	Undetermined

State Site Number	Project Vicinity	Site Type[a]	Brief Description[b]	Temporal / Cultural Affiliation	Location Relative to the Project	National Register Eligibility
VT-WN-192	Springfield, VT	P	Previously recorded as hearths*	Pre-contact (unknown)	Fee-owned/flowage	Undetermined
VT-WN-260	Windsor, VT	P	Previously recorded as three pieces of quartz chipping debris*	Pre-contact (unknown)	Flowage	Undetermined
VT-WN-450	Springfield, VT d	P	Previously recorded as two hearths*	Pre-contact (unknown)	Flowage	Undetermined
VT-WN-453	Springfield, VT	P	Previously recorded as two to three possible living surfaces, two projectile points*	Pre-contact (Late Archaic)	Fee-owned/flowage	Undetermined
VT-WN-454	Springfield, VT	P	Previously recorded as projectile points, chipping debris, hammerstones, pottery, mostly surface collected*	Pre-contact (Late/Terminal Archaic)	Flowage	Undetermined
VT-WN-464	Weathersfield, VT	P	Previously recorded as chipping debris, possibly in a secondary context*	Pre-contact (unknown)	Flowage	Undetermined
VT-WN-473 (new)	Windsor, VT	P	Three pieces of quartz	Pre-contact	Flowage	Undetermined

State Site Number	Project Vicinity	Site Type[a]	Brief Description[b]	Temporal / Cultural Affiliation	Location Relative to the Project	National Register Eligibility
			chipping debris	(unknown)		
VT-WN-474 (new)	Weathersfield, VT	P	Five meter long black soil stain with a localized fire-reddened patch; probably hearth and/or living surface	Pre-Contact (unknown)	Flowage	Undetermined
VT-WN-475 (new)	Springfield, VT	P	Low density of quartz and quartzite chipping debris originally identified in 1997	Pre-contact (unknown)	Flowage	Undetermined
VT-WN-476 (new)	Springfield, VT	H	A pair of old bridge abutments	Euro-American (1860-1929; may be earlier, but no later than 1959	Flowage	Undetermined

[a] P = Strictly pre-contact, PH = Multi-component site with pre-contact and historic components, H = strictly historic-era.

[b] * = No exposed cultural materials identified during Phase IA reconnaissance survey (Hubbard et al., 2012).

Table 3.12-2. Post-contact sites within the Bellows Falls shoreline study area identified on historic maps (Vermont)

ID Number	Description	Identification on Historic Maps					Notes
		Walling (1860)	**Beers (1869)**	**USGS (1929)**	**USGS (1930)**	**USGS (1957)**	
RO-1	Dwelling		Appears as *D.K. Barry*		X		
RO-2	Dwelling		Appears as *G.C. Bidwell*				
RO-3	Cabins (13)				X (8 cabins)	X (10 cabins)	
SP-1	Schoolhouse			Appears as *River School*			
SP-2	Dwelling		Appears as *D.A. Gill*	X		X	
SP-3	Wentworth Ferry and Crown Point Road	X	Road only				
SP-4	Bridge abutments	X	X	X			VT-WN-476
SP-5	Schoolhouse		Appears as *School No, 19*				

ID Number	Description	Identification on Historic Maps					Notes
		Walling (1860)	**Beers (1869)**	**USGS (1929)**	**USGS (1930)**	**USGS (1957)**	
WE-1	Dwelling (Probably destroyed by new Ascutney Bridge)		X Appears as *H.H. Graves*	X		X	Probably destroyed by new Ascutney Bridge
WE-2	Ferry launch and ferry house	X	Ferry only appears as *Ashley's Ferry*	X			
WE-3	Tuttle Cemetery (In use between 1772-1882)					X	In use 1772-1882; visible gravestones
WE-4	Bridge abutments	X Appears as *Claremont Bridge*	X	X		X	

Table 3.12-3 Post-contact sites within the Bellows Falls shoreline study area identified on historic maps (New Hampshire)

ID Number	Description	Identification on Historic Maps						Notes
		Holland (1784)	Walling (1860)	Hurd (1892)	USGS (1929)	USGS (1930)	USGS (1957)	
CH-1	Dwelling			X	X		X	Possible 27-SU-34
CH-2	Dwelling				X		X	Likely 27-SU-4
CH-3	Dwelling						X	Likely 27-SU-4
CH-4	Dwelling					X	X	
CH-5	Dwelling					X		27-SU-46
CH-6	Possible trout pond			X				27-SU-49
CH-7	Ferry launch		Appears as *Ferry*					
CL-1	Dwelling			Appears as *C.V. Paddock II*				
CL-2	Bridge abutment		X	X	X		X	
CL-3	Toll house		Appears as *Toll*	Appears as *Toll*	X			

ID Number	Description	Identification on Historic Maps						Notes
		Holland (1784)	**Walling (1860)**	**Hurd (1892)**	**USGS (1929)**	**USGS (1930)**	**USGS (1957)**	
			House	*House*				
CL-4	Dwelling	X						
CL-5	Ferry launch (Appears as *Ashley's Ferry* on Carrigain 1816 map)		Appears as *Ashley's Ferry*		Appears as *Ashley's Ferry*			Carrigain (1816) map appears as Ashley's Ferry
CL-6	Dwelling		Appears as *I. Hubbard Esq.*	Appears as *L.H. Long*				
WA-1	Rail spur					X	X	27-CH-169

Bellows Falls Island MRA

The Bellows Falls Island Multiple Resource Area (MRA) encompasses a 30-acre "island" formed by the 1792-1802 Bellows Falls Canal and the Connecticut River. The river in this location consists of a narrow, steep-sided gorge with a 60-foot cascade known as the "Great Falls" or "Bellows Falls." The canal separates Bellows Falls Island from the mainland and has provided water for industrial purposes since construction of the first timber dam in 1802, and later for hydroelectric purposes. The canal was first listed on the National Register on August 16, 1981, as part of the Bellows Falls Downtown Historic District, which is not located within the Project APE. However, the Project includes three fee-owned parcels of land on Bellows Falls Island that total 17 acres and include a portion of the Bellows Falls Island MRA located in the APE; this property was listed on the National Register on September 26, 1988 (Mulholland, 1988b).

Contributing to the significance of the Bellows Falls Island MRA are three pre-contact sites (one of which, the petroglyphs found at VT-WD-8, is also located within the Project APE) and 13 historic-era architectural structures and complexes. The historic-era resources include:

- the New England Power Company (now TransCanada) hydroelectric generating station (1927), also known as the Bellows Falls Hydroelectric Development Historic District;
- the site of the former Fall Mountain Paper Company stockhouse (ca. 1880);
- the Hydrant house;
- the Bellows Falls Times/Vermont Newspaper Corporation complex (ca. 1930s);
- a gas station (ca. 1935),
- The Adams Gristmill warehouse (ca. 1925);
- the Howard Hardware storehouse (ca. 1895);
- the Bellows Falls Cooperative Creamery complex (ca. 1918-1964), the Robertson Paper Company complex (ca. 1890-1917, the Moore and Thompson Paper Mill complex (ca. 1880-1881, 1924-1925);
- the Boston and Maine Railroad passenger station (1922), the former Railway Express Agency office (ca. 1880), and
- the former Rutland Railroad freight house (ca. 1860).

Only the structures associated with the hydroelectric generating station are located within the Bellows Falls APE; however, while not explicitly mentioned in the National Register nomination form, site VT-WD-76 is associated with the Robertson Paper Company which is a contributing element.

The Bellows Falls Island MRA is significant because it represents varied pre-contact and historic uses of the area. Its location was attractive to pre-contact populations as evidenced by the elaborate petroglyphs of VT-WN-8, and by other habitation/burial sites. Relatively few petroglyph sites have been identified in the northeastern United States, and the intricate anthropomorphic designs are particularly important because they (1) are associated with a set of natural falls, (2) contain a “horned-head” design that may correlate with other shamanistic motifs identified elsewhere in the Northeast, and (3) may convey information about group identity and territory boundaries, ideology, social structure, and other cultural elements (Mulholland, 1988b).

During the historic period, the Bellows Falls Island was the location of intensive industrial activity, dominated at first by the paper industry, and later by large-scale hydroelectric generation. Although no longer in use, structural complexes associated with late nineteenth century paper manufacturing and a twentieth century creamery remain today.

Bellows Falls Hydroelectric Development Historic District

In 1802, Bellows Falls Hydro-Electric Corporation completed the construction of a timber dam across the Connecticut River at Bellows Falls. Improvements were made over time, including reconstruction of the dam in 1882, raising its elevation by approximately 2 feet, with 2 feet of flashboards. In 1907, the dam was rebuilt of concrete, but the elevation was not raised.

Construction of the existing power facilities was initiated in 1926 by the Sherman Power Construction Company of Worcester, Massachusetts (Mulholland, 1988b). A new dam was constructed at the northern end of the “island,” the canal was enlarged, and the current powerhouse was built. By 1928, the facility was generating power. The powerhouse is an exceptional example of Georgian Revival design expressed in part by elaborate precast concrete stylistic features (including cornices, a lion’s head, and gargoyles), and a copper-sheathed paneled oak door that contrasts with the brick masonry.

The hydroelectric system features, including Bellows Falls dam, have been determined eligible for listing on the National Register as a historic district. Known both as the as New England Power Company (now TransCanada) hydroelectric generating station and as the Bellows Falls Hydroelectric Development Historic District, the district is both individually eligible for the National Register and also contributes to the eligibility of the Bellows Falls MRA. While all of the components of the development except for the dam are listed on the National Register as part of the MRA, the district individually has not been listed. The dam is not included in the MRA because it is not located on Bellows Falls Island, the area that is covered by the MRA.

3.12.3 Sites of Cultural Significance to Indian Tribes

There are no federally recognized tribes in the states of Vermont and New Hampshire. However, on April 12, 2011, the state of Vermont formally recognized the Elnu Abenaki and Nulhegan Band of Coosuk Abenaki Nation as state-recognized Bands. Non-recognized tribes in the state of Vermont include the Traditional Abenakis of Mazipskwik and the Abenaki Nation of Mississquoi. In the state of New Hampshire, the Abenaki Nation of New Hampshire and the Pennacook New Hampshire Tribe are the primary Native American organizations.

As noted above, TCPs are defined as those cultural resources that are eligible for inclusion in the National Register because of their "association with cultural practices or beliefs of a living community that are (a) rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community" (Parker and King, 1998). These resources may include geographic places, natural resource procurement locations, and other features and locations of spiritual or cultural significance to Native American tribes.

To date, no Tribes have expressed concern regarding cultural resources, including potential TCPs, within the Project APE.

In addition to TCPs, Tribes may also have interests in previously unidentified archaeological resources that may be identified within the Bellows Falls APE during Project activities or during routine operation and maintenance. Should such materials be identified, TransCanada would:

1. Halt all work in the immediate vicinity of the discovery;
2. Assume that the find is eligible for listing in the National Register;
3. Protect it until a formal determination of eligibility can be made;
4. Consult with the New Hampshire or Vermont SHPO to determine if the find is significant; and
5. If the find is determined to be significant, continue to consult with the New Hampshire or Vermont SHPO to assess the effects of project activities on the property and to determine appropriate mitigation measures.

If human remains are encountered during Project operations or other Project activities, they would not be removed, and care will be taken to protect them in place from any activity that might result in vandalism or other damage. The appropriate county medical examiner and law enforcement agencies would be notified in accordance with applicable law. The treatment and disposition of any human remains would take into account the applicable state's SHPO consultation process and the ACHP's *Policy Statement Regarding Treatment of Human Remains and Grave Goods* (ACHP, 2007). TransCanada and the New Hampshire or Vermont SHPO and other parties, as determined by law, would be consulted according to the statutory processes. If protection in place is not possible and the remains must be removed, appropriate special permits would be obtained in consultation with the New Hampshire or Vermont SHPO prior to excavation, collection, or transportation of the remains

3.12.4 National Register of Historic Places Eligibility and Cultural Values

Individual resource significance can be defined in a number of ways. The legal definition of significance of a site for the National Register is codified at 36 C.F.R. § 60.4:

> *National Register criteria for evaluation.* The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and (a) **that are associated with events** that have made a significant contribution to the broad pattern of our history; or (b) **that are associated with the lives of persons** significant in our past; or (c) **that embody the distinctive characteristics** of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or (d) **that have yielded, or may be likely to yield, information** important in prehistory or history.[7]

In addition to the criteria set forth at 36 C.F.R. § 60.4, properties can have other cultural values that should be considered. Amendments to the National Historic Preservation Act in 1992 (§ 101(d)(6)(A)) specify that TCPs claimed by an Native American tribe may be determined eligible for inclusion in the Naitonal Register. No TCPs that are eligible for listing on the National Register have been identified within the Project APE.

Of the 43 archaeological resources in the study area, three are currently listed on the National Register (27-SU-5, VT-WD-8, VT-WN-41), and three are eligible for listing (27-SU-41, VT-WN-61, VT-WN-186). One of these resources also contributes to the eligibility of the Bellows Falls Island MRA (VT-WD-8) and another is unevaluated by may contribute to the MRA (VT-WN-76). The National Register eligibility of the remaining 36 documented resources within the APE has not been determined.

The Project includes three fee-owned parcels on the Bellows Falls Island that total 17 acres. These parcels include the hydroelectric powerhouse and associated forebay and tailrace, and portions of the Bellows Falls Canal, all of which are listed in the National Register as contributing elements of the Bellows Falls Island MRA. The period of significance for these structures is post-1900 with architecture and engineering identified as areas of significance. The Project also includes Bellows Falls dam, which was determined to be eligible for listing on the National Register as part of the Bellows Falls Hydroelectric Development Historic District, but is not currently listed.

[7] Emphasis added.

3.12.5 Project Effects

Archaeological and Historic-era Resources

The Phase 1A archaeological field investigations observed erosion along the impoundment shoreline in both Vermont and New Hampshire upstream of the Bellows Falls dam, the nature of which, along with identified archaeological resources and sensitive areas, are described in detail in Hubbard et al. (2012). The Phase 1A investigations found recent, high flow-related erosion along the shoreline that may be a result of flooding associated with Tropical Storm Irene. However, the primary objective of the investigation was to identify historic and archaeology resources within the APE, not to ascertain the causation, extent, and mechanics of the erosion observed. See further discussion of this in section 3.4, *Geology and Soils*. The majority of the previously recorded archaeological sites are situated at the edge of the river on first terraces where agricultural practices have strongly contributed to ongoing erosion, the loss of stabilizing vegetation, and ultimately bank slumping and failures. All nine of the newly identified pre-contact sites documented during the course of the survey were found in eroding banks below cultivated fields.

The single most effective long-term solution to bank erosion and the protection of riverside cultural resources is the maintenance of adequate vegetated riparian buffer zones (Vermont ANR, 1998, as cited by Hubbard et al., 2012). Where this buffer zone has been maintained along the Project shorelines, there was a notable absence of significant erosion and exposure of archaeological sites. In other places, for instance at the Great Meadow in Charlestown, New Hampshire, attempts by private landowners to comply with the provisions of the New Hampshire Shoreland Water Quality Protection Act are evident, but have not been in place long enough to curtail bank erosion. Vermont does not require a riparian buffer zone, which allows farmers to plant crops right to the top of the bank.

According to the Phase IA survey report, any attempt to assess the significance of unevaluated sites within the Bellows Falls APE or prioritize them would be premature because most are lacking detailed information necessary to make such determinations (Hubbard et al., 2012). However, based on information available from archival sources, including site reports, combined with the 2011 field observations and anticipated threats based on site location, geomorphology, soil characteristics, and erosion that may be Project related, the Phase IA report identified several of the known sites that are potentially significant and deserve special consideration.

Other Project-related activities that could affect cultural resources in the future include:

- ground disturbance associated with any new construction of new Project buildings or infrastructure;
- modification of Project shorelines, including those related to the installation of active soil erosion and sediment control measures, and re-vegetation measures;
- recreational use; and

- modifications to the character-defining features of contributing components of the Bellows Falls MRA or resources or structures that may be eligible for listing on the National Register.

Treatment of Historic Properties

TransCanada proposes to develop a Historic Properties Management Plan (HPMP) for the Project that would include a detailed discussion of an archaeological monitoring plan to determine the extent of any Project-related potential effects and further measures to manage sites and sensitive areas within the Project APE. These measures may include a plan for Phase IB identification and implementation of a Phase III data recovery program for unavoidable Project-related adverse effects. The HPMP would also include measures for the treatment of unanticipated cultural materials and human remains that could be discovered within the APE over any new license term.

Historic Hydroelectric System Features

The Project hydroelectric system components are listed on the National Register of Historic Places as contributors to the Bellows Falls Island MRA and are also eligible for listing as the Bellows Falls Hydroelectric Development Historic District, which is not currently listed. Throughout the term of any new License, activities such as maintenance, repair, alteration, replacement, and new construction may be necessary. In order to retain the historic integrity of the system and the MRA and the district, the HPMP would call for any major repairs or modifications to contributing elements that could adversely affect the integrity of the MRA to be performed in accordance with *the Secretary of the Interior's Standards for Rehabilitation* (48 FR 44738-44739) in consultation with the SHPO. Ideally, all repairs or modifications to National Register eligible or listed structures would be done utilizing the existing materials and in the same style and technique as the original. If repairs, modifications, or replacement are necessary for any of the National Register contributing electrical or mechanical elements, they would be replaced in kind by functionally equivalent parts, whenever possible. Maintenance and operation activities not subject to SHPO review would be identified in the Project HPMP.

3.12.6 References

ACHP (Advisory Council on Historic Preservation). 2007. Policy Statement Regarding Treatment of Burial Sites, Human Remains, and Funerary Objects. Advisory Council on Historic Preservation, Washington DC.

Cherau, S. 2007a. Archaeological Resources Assessment, Bellows Falls Hydroelectric Development, GSU Switchyard, Bellows Falls, Vermont. PAL Report No. 2095. Submitted to TransCanada Hydro Northeast, Inc. Concord, NH.

Cherau, S.. 2007b. Archaeological Resources Assessment, Bellows Falls Substation Revitalization Project, Bellows Falls, Vermont. PAL Report No. 2112. Submitted to TransCanada Hydro Northeast, Inc. Concord, NH.

Cherau, S. and G. Laskoski. 2010. Phase IB Archaeological Survey, G-33 Reconductoring and Refurbishment Project, Vermont Portion, Rockingham, Westminster, Putney, Dummerston, Brattleboro, Vermont. PAL Report No. 2154-2. Submitted to New England Power Company d/b/a/ National Grid (NEP), Waltham, MA.

Doherty, J. and M. Kierstead. 1999. Deerfield and Connecticut River Hydroelectric Projects System-wide Historical and Photographic Documentation. Report submitted to USGen, New England, Inc. (not seen, as cited in Hubbard et al, 2012)

Henry, H.H. 1981. National Register of Historic Places Nomination. On file, Vermont State Historic Preservation Office, Montpelier, VT.

Hubbard, M., S. Cherau, J. Elam, J. Daly, and O. Elquist. 2012. Phase IA Archaeological Reconnaissance Survey, Bellows Falls, Hydroelectric Project (FERC No. 1855), Windham and Windsor Counties, Vermont, and Cheshire and Sullivan Counties, New Hampshire. Public Archaeology Laboratory, Pawtucket, RI. Submitted to TransCanada Hydro Northeast, Inc. Concord, NH.

Olausen, S. and S. Cherau. 2011. Cultural Resources Assessment, National Grid Bellows Falls Revitalization Project, Activities Related to Access Roads and Laydown, Bellows Falls, Vermont. PAL Report No. 2112.05. Public Archaeology Laboratory, Pawtucket, RI. Submitted to Energy Initiatives Group, LLC, Sutton, MA.

PAL (Public Archaeology Laboratory). 2012. Technical Report – Phase 1A Archaeological Reconnaissance Survey, Bellows Falls Hydroelectric Project (FERC No. 1855). Windham and Windsor Counties, Vermont, and Cheshire and Sullivan Counties, New Hampshire. Pawtucket, RI. February.

Parker, P.L. and T.K. King. 1998. National Register Bulletin 38, Guidelines for Documenting and Evaluating Traditional Cultural Properties. U.S. Department of the Interior, National Park Service, National Register, History and Education, National Register of Historic Places. Washington, DC.

Vermont ANR (Vermont Agency for Natural Resources). 1998. Values of Riparian Buffers. http://www.anr.state.vt.us/dec/waterq/rivers/docs/rv_riparianvalues.pdf. (accessed January 12, 2012).

Vermont DHP (Vermont Division for Historic Preservation). 2002. Environmental Predictive Model for Locating Precontact Archeological Sites. Form dated May 23, 2002. Vermont Division for Historic Preservation, Montpelier, VT.

3.13 SOCIOECONOMIC RESOURCES

3.13.1 Overview

The communities of Grafton, Rockingham, Springfield, Wethersfield, and Windsor are located in Vermont, generally from south to north along the river, within close proximity to the Project. The communities of Walpole, Alstead, Charleston, Claremont, and Cornish are located in New Hampshire, from south to north along the river, within proximity to the Project.

3.13.2 Summary of Existing Studies

To describe the socioeconomic resources of the Project area, which includes Windsor and Windham counties in Vermont, and, Cheshire and Sullivan counties in New Hampshire, we consulted records of the U.S. Census Bureau and gathered information from relevant plans by Regional Planning Commissions, including the Windham Regional Plan (2006) and the Southern Windsor County Planning Commission Regional Plan (2009).

3.13.3 Land Use Patterns

This region is predominantly rural, and the vast majority of the land is undeveloped. Specifically, in the Windham Region (primarily Windham County, Vermont), 86 percent of the land is forested and only 6 percent is open space, which includes agriculture. Less than 5 percent of the region falls into urban or developed areas, such as residential, commercial, industrial, and public or semi-public uses. The remaining 3 percent is covered by water or wetlands (Windham Regional Commission, 2006). Physical limitations have played a dominant role in the region's development patterns, with linear development with the river and stream valleys establishing the road system along those streams, linking village nodes in each major valley (Windham Regional Commission, 2006).

Southwestern New Hampshire has similar development patterns, with dispersed residential development and very little agriculture (Southwest Region Planning Commission, 2002). The regional economy and high demand for access to rural living by professionals and laborers alike has created an increasingly suburban development pattern throughout much of the region. In southwestern New Hampshire, residential, commercial, industrial, and public/semi-public uses and roads occupy about 10 percent of total land uses. Another 13 percent of the region is protected from development by deed restrictions. The natural physical conditions found on almost 60 percent of the total land area pose limitations or special challenges to development either by invoking environmental regulations (wetlands or shorelines), or by physical difficulties (floodplains, steep slopes, or rock outcroppings). The remaining 17 percent, or 112,200 acres, of the region are undeveloped and possibly suitable for development (Southwest Region Planning Commission, 2002).

The region's open lands include some agriculture, and many of those lands are located in the Connecticut River Valley. Agriculture remains an important and defining component of the region's landscape, and the Connecticut River Valley has the largest amount of prime farmland in the region (Southern Windsor County Planning Commission, 2009; Windham Regional Commission, 2006).

3.13.4 Population and Demographic Patterns

Population in 2010 in Cheshire and Sullivan counties accounted for 9.2 percent of the New Hampshire population, while Windham and Windsor counties accounted for 16.2 percent of Vermont's population. These four counties have been growing at a slower rate than their respective states. Windsor County experienced negative population growth between 2000 and 2010, while the state experienced a slight 3 percent increase in population during this period. Table 3.13-1 summarizes these population trends.

Table 3.13-1. Population trends in the Project region (Source: U.S. Census, 2010a).

County or State	1990	2000	2010	Percent Change (1990-2000)	Percent change (2000-2010)
Cheshire County, NH	70,121	73,825	77,117	5%	4%
Sullivan County, NH	38,590	40,458	43,742	5%	8%
New Hampshire	*1,109,252*	*1,235,786*	*1,316,470*	*11%*	*7%*
Windham County, VT	41,588	44,216	44,513	6%	1%
Windsor County, VT	54,055	57,418	56,670	6%	-1%
Vermont	*562,758*	*608,827*	*625,741*	*8%*	*3%*

Table 3.13-2 displays the demographic information for the counties in the Project region as well as state information for comparison. The population density in the counties is lower than their respective state population densities, reflecting the rural nature of these counties. Additionally, the counties in the Project region have slightly older populations and higher proportions of white residents when compared to their respective state populations.

Table 3.13-2. 2010 Demographic statistics for counties in the Project region (Source: U.S. Census, 2010a).

Demographic Indicator	Windham County	Windsor County	Vermont	Cheshire County	Sullivan County	New Hampshire
Geography and Population						
Population	44,513	56,670	625,741	77,117	43,742	1,316,470

Demographic Indicator	Windham County	Windsor County	Vermont	Cheshire County	Sullivan County	New Hampshire
Area (Square Miles)	*785*	*969*	*9,217*	*707*	*537*	*8,953*
Population Density (persons per square mile)	57	58	67	109	81	147
Gender						
Male	*49.1%*	*49.0%*	*49.3%*	*48.8%*	*49.4%*	*49.3%*
Female	*50.9%*	*51.0%*	*50.7%*	*51.2%*	*50.6%*	*50.7%*
Age						
Persons under 5 years old	*4.8%*	*4.7%*	*5.1%*	*4.8%*	*5.3%*	*2.7%*
Persons under 18 years old	*19.9%*	*19.9%*	*20.7%*	*19.6%*	*21.0%*	*21.8%*
Persons 18 to 64 years old	*64.0%*	*62.3%*	*64.7%*	*65.7%*	*62.5%*	*64.7%*
Persons 65 years old and over	*16.1%*	*17.8%*	*14.6%*	*14.7%*	*16.5%*	*13.5%*
Race						
White	*95.3%*	*96.3%*	*95.3%*	*96.3%*	*97.0%*	*93.9%*
Black	*0.9%*	*0.6%*	*1.0%*	*0.5%*	*0.4%*	*1.1%*
American Indian and Alaska Native	*0.3%*	*0.3%*	*0.4%*	*0.3%*	*0.3%*	*0.2%*
Asian	*1.0%*	*0.9%*	*1.3%*	*1.2%*	*0.6%*	*2.2%*
Hispanic or Latin (for any race)	*1.7%*	*1.2%*	*1.5%*	*1.4%*	*1.1%*	*2.8%*
Two or More Races	*2.0%*	*1.7%*	*1.7%*	*1.4%*	*1.4%*	*1.6%*
Households						
Number of Households	*18,290*	*24,753*	*256,442*	*30,204*	*18,126*	*518,973*
Average Size of Households	*2.23*	*2.25*	*2.34*	*2.40*	*2.37*	*2.46*

Table 3.13-3 summarizes the cities and towns and their associated populations located adjacent to the Project. The Project is situated in parts of eight communities - Walpole, Charlestown, Claremont, and Cornish in New Hampshire, and Rockingham, Springfield, Weathersfield, and Windsor in Vermont. Rockingham, Vermont, with a population of almost 5,300 includes two

incorporated villages, Bellows Falls and Saxtons River, and the hamlets of Bartonsville, Brockways Mills, and Cambridgeport (hamlet is another word for an unincorporated rural village). Other larger communities in the area include Springfield, Vermont, 11 miles north of the Project, and Charlestown, New Hampshire, about 7 miles north of the Project.

Table 3.13-3. Cities and towns near the Project (Source: U.S. Census 2010a).

County	Cities and Towns	2010
Windham County, Vermont	Grafton	679
	Rockingham	5,282
Windsor County, Vermont	Springfield	9,373
	Windsor	3.553
	Weathersfield	2,825
Sullivan County, New Hampshire	Charlestown	5,114
	Claremont	13,355
	Cornish	1,640
	Newport	6,507
Cheshire County, New Hampshire	Walpole	3,734
	Alstead	1,937
	Chesterfield	3,604
	Hinsdale	4,046
	Westmoreland	1,874
Franklin County, Massachusetts	Greenfield	17,456

3.13.5 Employment and Income

The employed labor force in the four-county Project region was 115,000 in 2010 (table 3.13-4). The employed workforce in the New Hampshire counties accounts for 9 percent of New Hampshire's workforce, and the two counties in Vermont account for 16 percent of Vermont's employed workforce. The median household income was less than that of the respective state median household income.

Table 3.13-4. Labor force by County (Source: U.S. Census, 2010b).

Labor Force and Income	Cheshire, NH	Sullivan, NH	New Hampshire	Windham, VT	Windsor, VT	Vermont
Civilian Labor	44,472	24,160	745,784	24,872	31,191	351,795

Labor Force and Income	Cheshire, NH	Sullivan, NH	New Hampshire	Windham, VT	Windsor, VT	Vermont
Force						
Employed	40,141	22,812	696,250	23,247	29,229	328,350
Unemployed	4,331	1,348	49,534	1,625	1,962	23,445
Percent Unemployment	10%	6%	7%	7%	6%	7%
Median Household Income (2010$)	$52,644	$50,274	$61,989	$47,386	$51,229	$51,605

Table 3.13-5 summarizes employment by industry. Across the four Project region counties, educational services and healthcare and social assistance account for between 27 and 30 percent. Other important industries in the area include retail trade, accounting for between 11 and 13 percent, and manufacturing, accounting for between 9 and 18 percent of employment in the region.

Table 3.13-5. 2010 Employment by industry in Project counties (Source: U.S. Census, 2010b).

Industry	Cheshire, NH	Sullivan, NH	New Hampshire	Windham, VT	Windsor, VT	Vermont
Civilian employed population 16 years and over	40,141	22,812	696,250	23,247	29,229	328,350
Agriculture, forestry, fishing and hunting, and mining	0.8%	1.3%	0.8%	2.8%	2.3%	2.7%
Construction	6.5%	7.0%	7.2%	8.4%	9.1%	7.5%
Manufacturing	14.8%	17.5%	13.0%	9.9%	9.3%	10.4%
Wholesale trade	4.3%	2.5%	3.0%	4.0%	2.4%	2.6%
Retail trade	12.4%	12.9%	13.1%	10.7%	10.7%	12.0%
Transportation and warehousing,	4.3%	2.8%	3.8%	3.6%	3.8%	3.5%

Industry	Cheshire, NH	Sullivan, NH	New Hampshire	Windham, VT	Windsor, VT	Vermont
and utilities						
Information	1.6%	1.3%	2.2%	1.8%	2.2%	2.0%
Finance and insurance, and real estate and rental and leasing	5.3%	5.4%	6.7%	4.7%	4.8%	4.8%
Professional, scientific, and management, and administrative and waste management services	6.3%	9.3%	10.1%	7.1%	9.4%	8.9%
Educational services, and health care and social assistance	28.9%	26.5%	23.8%	29.5%	26.6%	27.2%
Arts, entertainment, and recreation, and accommodation and food services	8.3%	5.9%	8.1%	10.0%	10.6%	9.2%
Other services, except public administration	4.3%	3.9%	4.3%	4.2%	4.3%	4.4%
Public administration	2.1%	3.6%	3.8%	3.3%	4.5%	4.8%

3.13.6 Project Effects

Operation of the three Lower Connecticut River Hydroelectric Projects at Wilder, Bellows Falls, and Vernon has a considerable positive impact on the local economies in the region. Although there are employees assigned to each project, the crews rove between locations and address work project needs that arise. For that reason these effects are summarized for all three Lower Connecticut projects. The total union workforce payroll for the three projects for 2011 was $2.1 million and non-union payroll amounted to $850,000 for a total payroll impact of just under $3 million.

In addition to wages and benefits paid to employees who live locally, TransCanada also purchases many goods and services within the local area, including fuel, vehicle maintenance, plant-related consumables and equipment, construction services and materials, and office supplies, among others. For 2011, materials purchased in the local area amounted to $156,000, and another $144,800 was paid to local vendors for services to the three projects including the Operations Center at Wilder and the engineering and support functions in Lebanon and North Walpole, New Hampshire.

TransCanada, through its Community Investment Program, also contributed approximately $170,000 in charitable donations in 2011 to 28 qualified non-profit grantee organizations serving the region (combined for the Wilder, Bellows Falls, and Vernon Projects). The grants were made for a variety of educational, environmental, social service, arts and culture, and health and wellness projects to benefit the region.

Finally, TransCanada is a large property owner, and in 2011, paid more than $8 million in local property taxes to New Hampshire and Vermont communities within all three Lower Connecticut project boundaries. In addition, TransCanada pays business taxes to the states of New Hampshire and Vermont as well as utility property tax in New Hampshire.

3.13.7 References

Southwest Region Planning Commission. 2002. Guiding Change: The Southwest Region at the Beginning of the 21st Century. Available at: http://www.swrpc.org/files/data/library/general/SWRPC%20Regional%20Plan.pdf. (accessed September 11, 2012).

Southern Windsor County Planning Commission. 2009. 2009 SWCRPC Regional Plan. Available: http://swcrpc.org/wp/wp-content/uploads/2011/08/2009-SWCRPC-Regional-Plan.pdf. (accessed October 15, 2012).

U.S. Census. 2010a. 2010 Decennial Census, SF1. Total Population for Counties and County Subdivisions. Available: http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t.

U.S. Census. 2010b. American Community Survey, 2008-2010 Estimates for Counties, States, and County Subdivisions. Available: http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t.

Windham Regional Commission. 2006. Windham Regional Plan. Available: http://windhamregional.org/images/docs/regional-plan/2006_windham_regional_plan.pdf. (accessed October 15, 2012).

3.14 TRIBAL RESOURCES

3.14.1 Summary of Existing Studies

The following sources of information were checked for information about tribes in Vermont and New Hampshire who may have resource interests in the Project region:

- Abenaki Nation of Missisquoi. http://tribal.abenakination.com (accessed August 22, 2012).
- Bureau of Indian Affairs. http://www.bia.gov (accessed August 22, 2012).
- Cowasuck Band–Pennacook/Abenaki people. http://www.cowasuck.org
- Elnu Abenaki tribe. http://elnuabenakitribe.org (accessed August 21, 2012).
- Koasek Abenaki of the Koas http://www.koasekabenaki.org (accessed August 22, 2012).
- Koasek Traditional Band of the Sovereign Abenaki Nation http://www.cowasuckabenaki.com (accessed August 22, 2012).
- Mashantucket Pequot Museum and Research Center. http://www.pequotmuseum.org (accessed August 22, 2012).
- National Conference of State Legislatures. http://www.ncsl.org/issues-research/tribal/list-of-federal-and-state-recognized-tribes.aspx#State (accessed August 21, 2012).
- Nulhegan Band of Coosuk Abenaki Nation. http://www.abenakitribe.org (accessed on August 22, 2012).
- New Hampshire Division of Historic Resources http://www.nh.gov/nhdhr (accessed August 21, 2012).
- Vermont Commission on Native American Affairs. http://vcnaa.vermont.gov (accessed on August 21, 2012).
- Vermont Division for Historic Preservation. http://accd.vermont.gov/strong_communities/preservation (accessed August 21, 2012).

3.14.2 Indian Tribes

There are no federally recognized tribes in the states of Vermont and New Hampshire.

Vermont law 1 V.S.A. §§ 851–853 recognizes Abenakis as Native American Indians. Vermont Governor Peter Shumlin signed legislative bills on April 22, 2011, that recognized the Elnu Abenaki and Nulhegan Band of Coosuk Abenaki Nation as state-recognized Bands. The Koasek Abenaki of the Koas tribe and the Missisquoi Abenaki tribe were both recognized by the state on May 17, 2012.

According to the New Hampshire Division of Historic Resources (http://www.nh.gov/nhdhr/review/tribal_list.htm), Native American organizations with interests in the state include the Abenaki Nation of New Hampshire, the Cowasuck Band–Pennacook/Abenaki people, the Koasek Abenaki of the Koas, Koasek Traditional Band of the Sovereign Abenaki Nation, the Nulhegan Band of the Coosuk Abenaki Nation, and the Abenaki Nation of the Missisquoi.

3.14.3 Tribal Lands

There are no tribally owned lands located within the project area.

3.14.4 Tribal Interests and Project Impacts

Indian Trust Assets (ITAs) are legal interests in assets held in trust by the federal government for Native American tribes or tribal individuals. Assets can be real property, physical assets, or property rights. Examples of ITAs are lands, including tribal reservations and allotments, mineral rights, water rights, hunting and fishing rights, and rights to other natural resources. ITAs do not include things in which a tribe or individuals have no legal interest.

TransCanada's records do not indicate the presence of any ITA lands or granted rights, easements, or permits to property or resources within the Project boundary or on TransCanada fee-owned lands.

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4.0 PRELIMINARY ISSUES AND STUDIES LIST

4.1 RESOURCE ISSUES

This section identifies issues associated with the potential effects of the continued operation of the Project under a new license, initial study proposals based upon these issues, and current and proposed protection, mitigation, and enhancement (PM&E) measures by TransCanada to address these issues.

In section 3, we describe the existing environment based on available information, and identify project effects. Several consultation meetings were held between 2009 and 2012 in an attempt to brief State and Federal agencies on the upcoming relicensing and discussed resource information needs for the PAD development (see section 5, *Contacts and Consultation*). TransCanada also requested feedback relative to studies it could initiate in advance of the PAD that would, 1) address obvious gaps in pre-PAD information and 2) be studies or initiatives that would be necessary to evaluate resources and project impacts. The following list represents the studies and initiatives undertaken in advance of drafting the PAD and their current status as of this document:

- GIS/Digital project maps – under development at present
- Lower Connecticut River Project Shoreline Survey and Mapping - completed; report or material to be finalized
- Vernon fish ladder shad effectiveness evaluation – study completed by USGS; report pending
- Water Quality monitoring – field work completed; report pending
- Dwarf wedge mussel survey of waters affected by the three projects – field work completed; final report pending TransCanada review
- Jesup's milk vetch habitat stage-flow rating curve development – field work completed; report pending
- Rare, threatened, and endangered species survey of the project reservoir edges – field work completed; report for TransCanada is pending
- River operations optimization/simulation model - under development at present
- Phase 1A historic and archaeological reconnaissance surveys of the Bellows Falls and Wilder Projects - field work completed; report pending

Beyond discussion about PAD data and information needs and the specific initiatives indicated, TransCanada has presented facility information and the operations overview to state and federal agencies and interested organizations and stakeholders at various outreach and consultation meetings over the past three years (see section 5, *Contacts and Consultation*). We solicited comments or concerns at each of those meetings and those expressed are represented in this section.

4.2 GEOLOGY AND SOILS

4.2.1 Preliminary Issues

The Project shoreline has experienced erosion at a number of locations. Most were well documented by surveys conducted by TransCanada in 2008. In August 2011, Tropical Storm Irene caused extensive flooding in the tributaries affecting the Project and the main stem Connecticut River experienced sustained extreme high water levels followed by extreme low reservoir levels for a brief period as stanchion bays were re-built at the dam. Erosion specific surveys have not been performed post-Irene except for the Phase 1A investigations which occurred very shortly thereafter. The Phase 1A investigation found extensive Irene related impacts along the shoreline but the primary objective of the investigation was to evaluate historic and archaeology resources, not to ascertain the extent and mechanics of the erosion observed.

A study conducted for USACE of the entire Connecticut River in 1979 concluded that erosion at the Project typically occurs at elevations higher than the Project's normal operating range and would occur with or without the Project. Normal operations are not a significant contributor to erosion in the reservoir compared to naturally occurring high river flows coupled with highly susceptible soils and agricultural uses.

During high flow periods, the Project is operated to minimize the potential for flooding via impoundment drawdown to maintain reservoir elevations at non-flood levels to the extent possible. It should be noted that standard procedures specify upstream storage and operations at the Fifteen Mile Falls Project be utilized, to the extent possible, to limit flows at Bellows Falls and prevent the need to trip stanchions at the dam. Unfortunately, in the case of Tropical Storm Irene, extreme high flows that resulted in having to trip stanchions bays was caused by tributary inflow downstream of the Fifteen Mile Falls Project.

4.2.2 Proposed Studies

No studies are being proposed specific to geology or soils resources. TransCanada views erosion as a principally natural process that can be observed on all river systems to varying degrees, whether managed or natural and free-flowing. Consideration of the role of the Project within the context of natural flows, susceptible soils, climate change and micro-climate events, long-term fluvial geomorphology processes, riparian land use and vegetation, and a complex of other factors would be essential to isolate the Project and any associated operational impacts.

4.2.3 Continued or Proposed PM&E Measures

There are no PM&E measures under the existing license relative to geology and soil resources, and none are proposed at this time. Information from the 2008 survey will be made available to the public for review and comment through the relicensing website: www.transcanada-relicensing.com.

4.3 WATER RESOURCES

4.3.1 Preliminary Issues

Water resources are finite yet highly variable due to annual and seasonal snow pack and storm related precipitation events, both of which affect upstream hydro project storage, flow augmentation and generation as well as inflows from the unregulated portions of the Project's drainage area. In order for the Project to contribute and perform its vital role in the New England energy mix, it must take this water resource and optimize its use and value within the confines of a deregulated energy market geared toward utilizing the most inexpensive energy available for the consumer. There is likely a general knowledge gap with respect to how these water resource variables affect the operation of the Project within the confines of the regional energy market in terms of both reservoir operation or Project discharge, and electric generation and economics. The relationship and operation between the Bellows Falls operation within the context of the other five hydroelectric projects, and how they all interact and are affected comprehensively is also unknown.

Bellows Falls dam modifies the physical environment of this section of the Connecticut River by increasing depth, time-of-travel (flushing rate), and in the lower portion of the impoundment, width. Available historical and current data indicate that water quality conditions upstream, downstream, and within the Bellow Falls Project meet state standards. Water quality data suggest that the Project has no significant impact on temperature or DO or other chemical parameter in the river or on other chemical parameters. It is not anticipated that continued operation would adversely affect water quality. However, current comprehensive water quality data specific to the Project is somewhat lacking and necessary

4.3.2 Proposed Studies

TransCanada proposes to develop a river optimization model that will optimize water resources, generation or value, and provide analytical results and outputs to make determinations or develop alternatives. Operating scenarios will be evaluated against a baseline scenario representing existing operation. Inputs will be naturalized inflow. Constraints will reflect current operating requirements in existing project licenses as well as allow for alternative constraints to be developed within the projects up for relicensing. Outputs in terms of discharge will be available for use by downstream projects with other models known to be under development. Further discussion of TransCanada's river model will occur within an anticipated river modeling working group composed of stakeholders and downstream hydro operators.

To address the lack of project-specific water quality data, TransCanada conducted a water quality study at the Project in 2012 based upon pre-PAD agency consultation and study plan review. The summary results are provided in the PAD. The full report is pending and will be available shortly.

4.3.3 Continued or Proposed PM&E Measures

No specific PM&E measures are proposed at this time beyond continuing the existing operational constraints including reservoir operations, high water procedures and minimum flows.

4.4. FISH AND AQUATIC RESOURCES

4.4.1 Preliminary Issues

The Bellows Falls dam is one of numerous dams on the Connecticut River that affect anadromous fish and can interrupt habitat connectivity for resident fish. However, existing upstream and downstream passage facilities provide access to habitat for both anadromous and resident fish.

Hydroelectric generation can cause potential instream and reservoir related effects on fish and aquatic resources. The normal reservoir operating range of approximately 2 feet daily at Bellows Falls minimizes fluctuations that could affect fish spawning recruitment. Vermont Fish & Wildlife and New Hampshire Fish & Game annually stock resident fish species in tributaries to the Vernon Project. Up until July 2012, FWS coordinated the stocking of Atlantic salmon fry and smolts. Based upon the available information, no immediate resource issues with regard to fish habitat or fish passage are apparent.

The bypass reach is approximately 3,500 feet long, and currently receives inflow from leakage through dam gates under normal Project operations. There is no minimum flow requirement from the dam under the current license. A barrier dam is located at the downstream end of the reach to keep fish from entering the bypass during spill and potentially becoming stranded later. No studies have been conducted to determine if the bypass reach would provide suitable habitat or if it would increase existing habitat in a meaningful way.

TransCanada conducted mussel surveys at the Project in 2011 that identified five mussel species downstream of the Bellows Falls dam and seven species in the reservoir, including the federally listed dwarf wedgemussel. See section 4.7 for issues related to dwarf wedgemussel. Threats to mussels include stranding from water level fluctuations, water quality degradation, sedimentation, erosion, and river channel alteration

4.4.2 Proposed Studies

At this time, absent additional stakeholder comment, issue scoping and consultation and discussion, TransCanada is not proposing studies specific to fish and aquatic resources.

4.4.3 Continued or Proposed PM&E Measures

TransCanada will continue to operate the upstream fish ladder and downstream fish passage facilities for Atlantic salmon and will maintain the fish counting facility to monitor the effectiveness of the fish ladder.

4.5 WILDLIFE AND BOTANICAL RESOURCES

4.5.1 Preliminary Issues

Terrestrial wildlife and botanical species likely to be impacted by Project operations include those species that utilize the edges of the river. Most wildlife species will not be adversely affected by the approximate 2-foot normal daily water level fluctuation. Species that may experience habitat degradation include those that rely on shallow benthic infauna (migratory shorebirds). The bank erosion may be deleterious to plant species that occupy the riparian zone, but may benefit some wildlife, including bank-nesting species (belted kingfisher and bank swallows), and mink and otter that utilize undercut riverbanks for travel and cover.

Terrestrial wildlife species that utilize project lands on Bellows Falls include migratory birds, and most local wildlife.

Shoreline botanical resources are impacted within the 2-foot normal water level zone due to the frequent wetting and drying, for which few species are adapted. On the riverbank immediately above that zone, herbaceous plant diversity tends to be high and includes a number of rare species. The habitat for these species is maintained by water and ice during high flow events. This disturbance also creates opportunities for invasive plant species to colonize this zone, as documented by the large number of known invasives on the Connecticut River, many of which occur in the Project.

4.5.2 Proposed Studies

At this time, absent additional stakeholder comment, issue scoping and consultation and discussion, TransCanada is not proposing studies specific to general wildlife or botanical resources. See section 4.7 for a discussion of rare, threatened and endangered plant species.

4.5.3 Continued or Proposed PM&E Measures

No specific PM&E measures are proposed at this time.

4.6 WETLANDS, RIPARIAN, LITTORAL, AND FLOODPLAIN HABITAT

4.6.1 Preliminary Issues

Project operations have the potential to impact wetland, floodplain, riparian, and littoral resources similarly to those described for wildlife and botanical resources (Section 4.5.1). The shoreline zone affected by the approximate 2-foot normal daily water level fluctuation includes habitats within all of the categories in this section: wetland, floodplain, riparian and littoral. The scour zone in the upper riverbank similarly affects portions of wetland, floodplain and riparian habitats.

4.6.2 Proposed Studies

At this time, absent additional stakeholder comment, issue scoping and consultation and discussion, TransCanada is not proposing studies specific to wetlands, riparian, littoral, and floodplain habitat resources. TransCanada is, however, in active consultation with State of Vermont agencies with respect to management planning and addressing issues on certain sensitive ownerships and land uses within the Project area.

4.6.3 Continued or Proposed PM&E Measures

No specific PM&E measures are proposed at this time.

4.7 RARE, THREATENED, AND ENDANGERED SPECIES

4.7.1 Preliminary Issues

The Project is known to support 43 rare, threatened, and endangered (RTE) species, including two federally listed species: dwarf wedgemussel, and Jesup's milk vetch. Project operations have the potential to affect RTE species that occur within the influence of the river. Plants, which comprise 37 of the 43 listed species, may be adversely affected by erosion and scour, as well as fluctuating water levels. In 2012, TransCanada conducted studies to document locations and status of known populations in the Project area, and approximate their position relative to normal daily water levels in order to assess the potential influence of project operations on these species (Section 4.7.2)

TransCanada conducted mussel surveys at the Project in 2011 that identified five mussel species downstream of the Bellows Falls dam and seven species in the reservoir, including the dwarf wedgemussel. Dwarf wedgemussel was found at nine survey sites, two sites in the Black River, one site in the Connecticut River downstream of the Black River, and six survey sites in the Connecticut River upstream of the Black River. Threats to the dwarf wedgemussel include stranding from water level fluctuations, water quality degradation, sedimentation, erosion, and river channel alteration.

4.7.2 Proposed Studies

Based on pre-PAD agency consultation, issue identification, study request and study plan collaboration, in the 2012 growing season, TransCanada conducted a study of listed threatened or endangered plants and communities within the likely influence of Project impoundment. TransCanada consulted with FWS, the New Hampshire Natural Heritage Bureau and the Vermont Natural Heritage Inventory Program to define the appropriate level of effort and list of species to be included in this study. The purpose of the study is to confirm the records of known occurrences, to survey for new occurrences in likely habitats, and to determine the potential Project impacts on the individual populations and habitats. The field survey documented the current status of individual populations of all plant species listed by New Hampshire and Vermont that are potentially influenced by project operations. A report on the study is pending and will be available shortly.

This survey may be expanded to include non-project affected project lands owned by TransCanada as well as downstream affected riparian areas above the limits of the downstream Vernon impoundment.

A separate hydrologic study was undertaken by TransCanada in the 2012 growing season to facilitate New Hampshire's and Vermont's long-term monitoring of Jesup's milk vetch, a federally and state-listed endangered species. One of the three known locations for this species occurs within the northern end of the Bellows Falls impoundment at Jarvis Hill. TransCanada's study developed stage-discharge rating curves for the four Jesup's milk vetch monitoring sites, including the Cornish Ledges introduction site, relative to flows at the USGS West Lebanon gage with the goal of determining at what flows certain features may become inundated, such as established reference bolts and plant locations. This study found no evidence to suggest that normal operational flow ranges affect Jesup's milk vetch individuals or populations, but that the plant occurs within elevations that bracket annual peak flows. The lowest Jesup's milk vetch plants grew at elevations that equated approximately triple the daily operational flows from Wilder (700 to 10,500 cfs). The final study report will be available shortly.

At this time, absent additional stakeholder comment, issue scoping and consultation and discussion, TransCanada is not proposing additional studies specific to Jesup's milk vetch. TransCanada is, however, in active consultation with State of Vermont agencies with respect to management planning and addressing issues on certain sensitive ownerships and land uses within the Project area.

4.7.3 Continued or Proposed PM&E Measures

Proposed PM&E measures will be based on the results of the rare, threatened and endangered species studies.

4.8 RECREATION AND LAND USE

4.8.1 Preliminary Issues

Continued operation of the Project could affect adequate access to Project lands and waters for recreational use given the limited acreage within the Project boundary. However, a variety of existing recreational opportunities appear to adequately meet the demand for fishing, boating, camping, picnicking, swimming, hunting, nature viewing and at the Project and therefore over-development or increased opportunities of some forms of recreation can create conflicts with and impact values associated with existing recreational activities and uses.

4.8.2 Proposed Studies

At this time, absent additional stakeholder comment, issue scoping and consultation and discussion, TransCanada is not proposing studies specific to recreational resources.

4.8.3 Continued or Proposed PM&E Measures

TransCanada will continue to operate and maintain the five existing recreation facilities at the Project throughout the term of any new license and will continue to permit state and local governments to operate an additional six recreational facilities that provide access to Project lands and waters for recreational boating, fishing, picnicking, and environmental education.

4.9 AESTHETIC RESOURCES

4.9.1 Preliminary Issues

Reservoir fluctuations would remain the same under the proposed operations. No additional issues have been identified relative to aesthetic resources.

4.9.2 Proposed Studies

At this time, absent additional stakeholder comment, issue scoping and consultation and discussion, TransCanada is not proposing studies specific to aesthetic resources.

4.9.3 Continued or Proposed PM&E Measures

No PM&E measures have been identified and none are proposed.

4.10 CULTURAL RESOURCES

4.10.1 Preliminary Issues

Continued operation of the Project has the potential to affect known or as yet unknown archaeological sites and historic properties. While prior cultural resources inventories and the Phase IA archaeological survey assisted in the identification of cultural resources within the Project APE, the full assessment of specific Project effects resulting from Project operation, maintenance and recreation use, on all cultural resources in the Project APE, including hydroelectric system features has not yet been completed. TransCanada proposes periodic monitoring of select locations for shoreline changes on specific archaeological sites and sensitive areas identified within the FERC license boundary during the Phase IA archaeological survey. Should identified impacts on sites and sensitive areas be determined to be Project-related during the monitoring, then Phase IB identification survey may be required to determine the presence of previously unrecorded sites and the significance of recorded sites (Hubbard et al., 2012).

Development of a management plan to address the potential adverse effects of project-related activities on such resources would ensure compliance with section 106 of the National Historic Preservation Act as amended.

4.10.2 Proposed Studies

In consultation with state SHPOs, TransCanada completed Phase IA surveys of the Project APE. The field work has been completed and the reports are under final preparation for distribution to the SHPOs for review and comment. Archaeological and historical sites as well as archaeologically sensitive areas along the shoreline have been identified on maps. Pending comments from the SHPOs, Phase IB studies may be required at some of the sites.

4.10.3 Continued or Proposed PM&E Measures

TransCanada proposes to develop a Programmatic Agreement (PA) that will be provided to the Vermont SHPO and New Hampshire SHPO, and eventually to the Commission. The PA will call for the development/implementation of a Historic

Properties Management Plan (HPMP) that would include a site monitoring plan, a plan for any Phase IB identification if required by the SHPOs, implementation of a Phase III data recovery program for unavoidable Project-related adverse effects to eligible properties, measures for the treatment of any hydroelectric system features determined to be eligible for listing on the National Register, and measures for the treatment of unanticipated cultural materials and human remains that could be discovered within the APE over any new license term.

4.11 SOCIOECONOMICS

4.11.1 Preliminary Issues

No issues have been identified relative to socioeconomic resources.

4.11.2 Proposed Studies

No studies are proposed.

4.11.3 Continued or Proposed PM&E Measures

No PM&E measures have been identified and none are proposed.

4.12 RELEVANT QUALIFYING COMPREHENSIVE PLANS

Section 10(a)(2)(A) of the FPA, 16 U.S.C. § 803 (a)(2)(A), requires the Commission to consider the extent to which a project is consistent with federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the project.

On April 27, 1988, the Commission issued Order No. 481-A, revising Order No. 481, issued October 26, 1987, establishing that the Commission will accord FPA section 10(a)(2)(A) comprehensive plan status to any federal or state plan that: (1) is a comprehensive study of one or more of the beneficial uses of a waterway or waterways; (2) specifies the standards, the data, and the methodology used; and (3) is filed with the Secretary of the Commission.

Under 18 C.F.R. § 4.38, each license application must identify relevant comprehensive plans and explain how and why a proposed project would or would not comply with such plans. The plans listed below are those on the Commission's August 2012 lists of comprehensive plans relevant to projects in New Hampshire and Vermont, excluding those not relevant to the Project, and those that appear on both the New Hampshire and Vermont lists.

New Hampshire

Atlantic States Marine Fisheries Commission. 1999. Amendment 1 to the Interstate Fishery Management Plan for shad and river herring. (Report No. 35). April 1999.

Atlantic States Marine Fisheries Commission. 2000. Technical Addendum 1 to Amendment 1 of the Interstate Fishery Management Plan for shad and river herring. February 9, 2000.

Atlantic States Marine Fisheries Commission. 2009. Amendment 2 to the Interstate Fishery Management Plan for shad and river herring, Arlington, Virginia. May 2009.

Atlantic States Marine Fisheries Commission. 2010. Amendment 3 to the Interstate Fishery Management Plan for shad and river herring, Arlington, Virginia. February 2010.

Atlantic States Marine Fisheries Commission. 1998. Interstate fishery management plan for Atlantic striped bass. (Report No. 34). January 1998.

Atlantic States Marine Fisheries Commission. 2000. Interstate Fishery Management Plan for American eel (Anguilla rostrata). (Report No. 36). April 2000.

Atlantic States Marine Fisheries Commission. 2008. Addendum II to the Fishery Management Plan for American Eel., ASMFC, Washington, D.C.

Connecticut River Atlantic Salmon Commission. 1992. A management plan for American shad in the Connecticut River Basin. Sunderland, Massachusetts. February 1992.

Connecticut River Joint Commissions. New Hampshire Department of Environmental Services. 1997. Connecticut River corridor management plan. Charlestown, New Hampshire. Concord, New Hampshire. May 1997.

Connecticut River Joint Commissions. New Hampshire Department of Environmental Services. Connecticut River corridor management plan: 2008 Update to the Water Resources Chapter: (a) Headwaters Region; (b) Upper Valley Region; (c) Wantastiquet Region; (d) Riverbend Region; and (e) Mt. Ascutney Region. Charlestown, New Hampshire. Concord, New Hampshire.

Connecticut River Joint Commissions. New Hampshire Department of Environmental Services. Connecticut River corridor management plan: 2009 Update to the Recreation Plan: (a) Headwaters Region; (b) Upper Valley Region; (c) Wantastiquet Region; (d) Riverbend Region; and (e) Mt. Ascutney Region. Concord, New Hampshire.

National Marine Fisheries Service. Amendment #1 to the Atlantic salmon Fishery Management Plan; and Components of the proposed Atlantic herring Fishery Management Plan for Essential Fish Habitat. Volume 1. October 7, 1998.

National Marine Fisheries Service. 1998. Final Recovery Plan for the shortnose sturgeon (*Acipenser brevirostrum*). Prepared by the Shortnose Sturgeon Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland. December 1998.

New Hampshire Office of State Planning. 1977. Wild, scenic, & recreational rivers for New Hampshire. Concord, New Hampshire. June 1977. 63 p.

New Hampshire Office of State Planning. 1989. New Hampshire wetlands priority conservation plan. Concord, New Hampshire. 95 pp.

New Hampshire Office of Energy and Planning. New Hampshire Statewide Comprehensive Outdoor Recreation Plan (SCORP): 2008-2013. Concord, New Hampshire. December 2007.

New Hampshire Office of State Planning. 1991. Public access plan for New Hampshire's lakes, ponds, and rivers. Concord, New Hampshire. November 1991. 65 pp.

State of New Hampshire. 1991. New Hampshire rivers management and protection program [as compiled from NH RSA Ch. 483, HB 1432-FN (1990) and HB 674-FN (1991)]. Concord, New Hampshire. 19 pp.

State of New Hampshire. 1992. Act designating segments of the Connecticut River for New Hampshire's rivers management and protection program. Concord, New Hampshire. May 15, 1992. 7 pp.

U.S. Fish and Wildlife Service. 1989. Atlantic salmon restoration in New England: Final environmental impact statement 1989-2021. Department of the Interior, Newton Corner, Massachusetts. May 1989.

Vermont (excluding those plans already listed above for New Hampshire)

Atlantic States Marine Fisheries Commission. 2000. Interstate Fishery Management Plan for American eel (Anguilla rostrata). (Report No. 36). April 2000.

Connecticut River Atlantic Salmon Commission. 1992. A management plan for American shad in the Connecticut River Basin. Sunderland, Massachusetts. February 1992.

Connecticut River Atlantic Salmon Commission. 1998. Strategic plan for the restoration of Atlantic salmon to the Connecticut River. Sunderland, Massachusetts. July 1998. 105 pp.

National Marine Fisheries Service. 1998. Amendment #1 to the Atlantic salmon Fishery Management Plan; and Components of the proposed Atlantic herring Fishery Management Plan for Essential Fish Habitat. Volume 1. October 7, 1998.

Vermont Agency of Environmental Conservation. 2002. White River Basin plan. Waterbury, Vermont. November 2002.

Vermont Agency of Environmental Conservation. 1986. Vermont Rivers Study.

Waterbury, Vermont. 236 pp.

Vermont Agency of Natural Resources. 1988. Hydropower in Vermont: an assessment of environmental problems and opportunities. Waterbury, Vermont. May 1988.

Vermont Agency of Natural Resources. 1988. Wetlands component of the 1988 Vermont recreation plan. Waterbury, Vermont. July 1988. 43 pp.

Vermont Agency of Natural Resources. 1986. The waterfalls, cascades, and gorges of Vermont. Waterbury, Vermont. May 1986. 320 pp.

Vermont Department of Fish and Wildlife. 1993. The Vermont plan for brook, brown, and rainbow trout. Waterbury, Vermont. September 1993.

Vermont Department of Forests, Parks and Recreation. Vermont State Comprehensive Outdoor Recreation Plan (SCORP): 2005-2009. Waterbury, Vermont. July 2005.

Vermont Natural Heritage Program. New Hampshire Natural Heritage Inventory. 1988. Natural shores of the Connecticut River: Windham County, Vermont, and Cheshire County, New Hampshire. December 1988.

Federal Agency Plans

National Park Service. The Nationwide Rivers Inventory. Department of the Interior, Washington, D.C. 1993.

U.S. Fish and Wildlife Service. Canadian Wildlife Service. 1986. North American waterfowl management plan. Department of the Interior. Environment Canada. May 1986.

U.S. Fish and Wildlife Service. Undated. Fisheries USA: the recreational fisheries policy of the U.S. Fish and Wildlife Service. Washington, D.C.

4.13 RELEVANT RESOURCE MANAGEMENT PLANS

New Hampshire

The following list includes additional relevant resource management plans not included in the list of Comprehensive Plans in section 4.12 above.

Guiding Change: The Southwest Region at the Beginning of the 21st Century. Southwest Regional Planning Commission. 2002.

New Hampshire Fish and Game Department Inland Fisheries Division 2011 Master Operational Plan. 2011.

New Hampshire Wildlife Action Plan. New Hampshire Fish & Game Department. 2007.

Upper Valley Lake Sunapee Regional Plan. Upper Valley Lake Sunapee Regional Planning Commission. 2005.

Vermont

Basin 10 Water Quality Management Plan – Ottauquechee River and Black River. Vermont Agency of Natural Resources. 2012.

Basin 11 Management Plan – West River, Williams River, Saxtons River. Vermont Agency of Natural Resources. 2008.

Southern Windsor County Regional Plan. Southern Windsor County Regional Planning Commission. 2009.

Vermont Bald Eagle Recovery Plan. Vermont Department of Fish and Wildlife. 2010.

Vermont Osprey Recovery Plan. Vermont Department of Fish and Wildlife. 1997.

Vermont Peregrine Falcon Recovery Plan. Vermont Department of Fish and Wildlife. 2000.

Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department. 2005.

Windham Regional Plan. Windham Regional Commission. 2006.

Federal Agency Plans

Dwarf Wedgemussel (Alasmidonta heterodon) Recovery Plan. United States Fish and Wildlife Service, Northeast Region. 1993.

Dwarf Wedgemussel (*Alasmidonta heterodon*) 5-Year Review: Summary and Evaluation. United States Fish and Wildlife Service New England Field Office. 2007.

Jesup's Milk Vetch Recovery Plan, United States Fish and Wildlife Service, Northeast Region. 1989.

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5.0 CONTACTS AND CONSULTATION

5.1 LIST OF CONTACTS USED TO PREPARE THE PAD

In addition to searches and reviews of publicly available data and information, TransCanada and its consultants made contact with federal, state, interstate agencies, NGOs, or the public for data or information relevant to the content of the PAD (table 5.1-1).

Table 5.1-1. Contacts used to prepare the PAD.

Resource Area	Nature of Contact	Agency/Organization name	Contact Person
Aquatics	Request for macroinvertebrate data	U.S. Environmental Protection Agency Region 1, Instream Flow Program	Ralph Abele
Aquatics	Request for macroinvertebrate data	New Hampshire DES Biological Monitoring Program	Dave Niels
Aquatics	Request for macroinvertebrate data	Vermont DEC, Biomonitoring Section	Steve Fiske
Fisheries	Request for fisheries data in CT River and tributaries	New Hampshire Fish & Game	Gabe Gries
Fisheries	Request for fisheries data in CT River and tributaries	Vermont Fish and Wildlife	Rod Wentworth, Ken Cox, Rich Kern, Lael Will
Fisheries	Request for fisheries data in CT River and tributaries	FWS	Ken Sprankle
Fisheries	Request to use/reference study reports	Vermont Yankee	Lynn DeWald
General	Inquiry about status of CT River Management Plan and updates	CRJC	Rachel Ruppel
Land Use	Vermont GIS data: lands with conservation easements	Windham Regional Commission	Jeff Nugent, GIS Planner
Land Use	Vermont GIS data: lands with conservation easements	University of Vermont, Spatial Analysis Lab	Sean MacFaden
Rare, Threatened and Endangered Species (RTE)	Request for publications related to natural communities and rare plants, and hydrologic modeling resources.	The Nature Conservancy	Doug Bechtel
Rare, Threatened and Endangered Species (RTE)	Request for information on GIS layers	NH Granit (NH GIS Clearinghouse)	

Resource Area	Nature of Contact	Agency / Organization name	Contact Person
Rare, Threatened and Endangered Species (RTE)	Request for information on bald eagle in the region	Audubon Society of New Hampshire	Chris Martin
Rare, Threatened and Endangered Species (RTE)	Request for information on species and refuge units	Silvo O. Conte National Fish and Wildlife Refuge	Mark Maghini
Water Quality	Inquiry about current VT river basin plans	Vermont DEC, Watershed Management Division	Marie Caduto
Water Quality	Location of mapping of Vermont's 303(d) and 305(b) rivers	Vermont DEC, Watershed Management Division	Tim Clear

5.2 SUMMARY OF PRE-PAD CONSULTATION

TransCanada has held or participated in several consultation meetings and public forums during the pre-PAD phase for parties interested in the relicensing of the Wilder, Bellows Falls, and Vernon projects. These meetings were held to educate stakeholders on the Projects' facilities and operations, discuss issues, and identify and develop pre-PAD study scopes and relicensing process and timetables. Most of the earlier meetings and consultation were with state and federal resource agencies. More recently, these meetings included FERC relicensing staff, NGOs, and members of the public.

Meeting with State and Federal Resource Agency Staff - September 28, 2009

TransCanada met with staff from New Hampshire, Vermont, and Massachusetts fishery and water quality agencies, and staff from FWS to discuss a number of Deerfield River and Connecticut River ongoing studies, mitigation plans, and proposed pre-relicensing activities. Related to relicensing, discussions mainly focused on a preliminary timetable for initiating relicensing and the potential for pre-PAD studies to be performed in 2010.

Meeting with State and Federal Resource Agency Staff – October 6, 2010

TransCanada met with staff from New Hampshire, Vermont, and FWS to discuss the status of water quality and fisheries related studies conducted in 2010 at Deerfield River and Connecticut River projects. The meeting was held at FWS offices in Concord, New Hampshire. Related to relicensing, discussions mainly focused on an overview of two pre-PAD studies that had been identified (dwarf wedgemussel and a shoreline survey) and on planning for a meeting in early 2011 to identify and invite all resource agency staff that would potentially be involved in TransCanada's upcoming relicensing.

Various consultation discussions and correspondence during 2010

Throughout 2010, consultation discussions and correspondence occurred between TransCanada and state and federal resource agency staff. The primary focus of these discussions was on a study related to a dwarf wedgemussel survey in which the identification of a preferred vendor, development of a scope of work, and initiating the study were discussed.

Pre-Licensing Meeting with State and Federal Resource Agency Staff - April 12, 2011

TransCanada met with agency representatives on April 12, 2011, to initiate discussion about the upcoming FERC relicensing of the Wilder, Bellows Falls, and Vernon projects. The purpose of the meeting was to provide agencies with an overview of how the Projects are operated and the primary parameters guiding operation, and to discuss preliminary issues and pre-PAD studies that could be conducted in 2011 and 2012 to support development of the PADs.

Table 5.2-1. Agencies represented at the 2011 pre-licensing meeting

NH Department of Cultural Resources
NH Department of Environmental Services
NH Fish and Game Department
NH Geological Survey
NH Department of Resources and Economic Development, Natural
VT Department of Environmental Conservation
VT Department of Fish and Wildlife
U.S. Fish and Wildlife Service

Various Consultation Discussions and Correspondence during 2011

Throughout 2011, numerous consultation discussions and correspondence occurred between TransCanada and state and federal resource agency staff. The primary focus of these discussions was on two studies. One related to initiating work on the dwarf wedgemussel survey, and the other related to a basin-wide American shad study to be conducted by USGS staff from the FWS Conte Research Laboratory with support from TransCanada, as the study scope included the Vernon Project. Additional discussions centered on a GIS-based shoreline erosion survey in advance of the relicensing of all three projects.

Jesup's Milk Vetch and Rare, Threatened, and Endangered Species Studies Initial Consultation Meeting - May 24, 2012

TransCanada conducted an agency consultation meeting on May 24, 2012, to discuss pre-PAD studies needed to fill known data gaps related to RTE species. Data sharing agreements and the proposed scopes of two studies planned for 2012 were discussed. Agency representatives provided input and recommendations on both the pre-PAD Jesup's milk vetch/Wilder flow study, and the pre-PAD rare plant/community survey along the river within the Wilder, Bellows Falls, and Vernon projects. Agencies represented at the meeting included New Hampshire Department of Resources and Economic Development, Natural Heritage Bureau, Vermont Fish & Wildlife, Endangered Species Program, and FWS.

Jesup's Milk Vetch Study Consultation 2012

On behalf of TransCanada, Normandeau staff engaged in ongoing consultation with the state and FWS representatives from the initial consultation meeting on the draft study plan for the pre-PAD Jesup's milk vetch/Wilder flow study to be conducted in 2012. Normandeau provided a draft study scope, and agency staff provided comments on it. The scope was subsequently revised to address those comments and received agency concurrence. Additional consultation occurred in the field during onsite surveys of the plants. The detailed consultation record will be included in the final study report.

Rare, Threatened, and Endangered Species Study Consultation 2012

On behalf of TransCanada, Normandeau staff engaged in ongoing consultation with the state and FWS representatives from the initial consultation meeting on the draft study plan for the pre-PAD RTE study encompassing the Wilder, Bellows Falls, and Vernon Project to be conducted in 2012. Normandeau provided a draft study scope and agency staff provided comments on it. The scope was subsequently revised to address those comments and received agency concurrence. The detailed consultation record will be included in the final study report.

Water Quality Study consultation 2012

On behalf of TransCanada, Normandeau staff engaged in ongoing consultation with New Hampshire and Vermont agency water quality staff on the pre-PAD baseline water quality study to be conducted in 2012, encompassing the Wilder, Bellows Falls, and Vernon projects. Normandeau provided a draft study scope, and agency staff provided comments on it. The scope was subsequently revised to address those comments and received agency concurrence. The detailed consultation record will be included in the final study report.

Pre-PAD Stakeholder Meeting - September 5, 2012

TransCanada identified more than 50 likely interested parties among state and federal resource agencies and NGOs and invited them to attend an introductory stakeholder meeting held on September 5, 2012, at the West Lebanon, New Hampshire, public library. Table 5.2-2 identifies the organizations that attended this meeting. The meeting introduced agency staff, NGOs, and the public to the relicensing for the Wilder, Bellows Falls, and Vernon Projects. The relicensing process and timetable were discussed by FERC representatives, and TransCanada representatives discussed the projects and their operations. Pre-PAD studies, both those already completed and those still in progress, were also described. Attendees were able to ask questions, identify issues, and provide comments on the projects and the relicensing process.

Table 5.2-2. Organizations represented at the pre-PAD stakeholder meeting.

American Rivers
Audubon Society of NH
Connecticut River Joint Commissions
Connecticut River Watershed Council
Federal Energy Regulatory Commission
National Park Service
NH Department of Environmental Services
NH Fish and Game Department
NH Rivers Council
The Nature Conservancy
U.S. Fish and Wildlife Service
Upper Valley Lake Sunapee Regional Planning Commission
VT Department of Environmental Conservation
VT Department of Fish and Wildlife
Windham Regional Commission

FERC Site Visits - October 1 through 3, 2012

FERC conducted its scoping meeting site visits prior to submittal of the PADs, so as to avoid winter weather conditions if the site visits were held after FERC's notice of commencement of relicensing proceedings as would normally happen. A one-day visit was conducted at Wilder, Bellows Falls, and Vernon, on October 1st, 2nd, and 3rd, respectively. FERC representatives introduced the role and authority of FERC, the relicensing process, and timetables. TransCanada representatives provided an overview of each project and its operations. Attendees were invited on guided facility tours and on boat tours on each project's reservoir. Attendees were able to interact directly with FERC and TransCanada representatives to ask questions and raise issues.

A total of 54 individuals (excluding TransCanada representatives) attended the Bellows Falls site visit. In addition to 13 members of the public, including local residents and representatives of downstream Connecticut River hydroelectric projects, 17 organizations were represented at the FERC site visit (table 5.2-3).

Table 5.2-3. Organizations represented at the Bellows Falls Project FERC site visit.

Audubon Society of New Hampshire
Bellows Falls Historical Society
Black River Action Team
Connecticut River Joint Commissions
Connecticut River Watershed Council
Federal Energy Regulatory Commission
National Park Service
NH Department of Environmental Services
NH Fish and Game Department
Society for the Protection of New Hampshire Forests
The Nature Conservancy
Town of Rockingham VT
Trout Unlimited
U.S. Fish and Wildlife Service
VT Department of Environmental Conservation
VT Department of Fish and Wildlife
Windham Regional Commission

ATTACHMENT 1

PROJECT BOUNDARY MAPS

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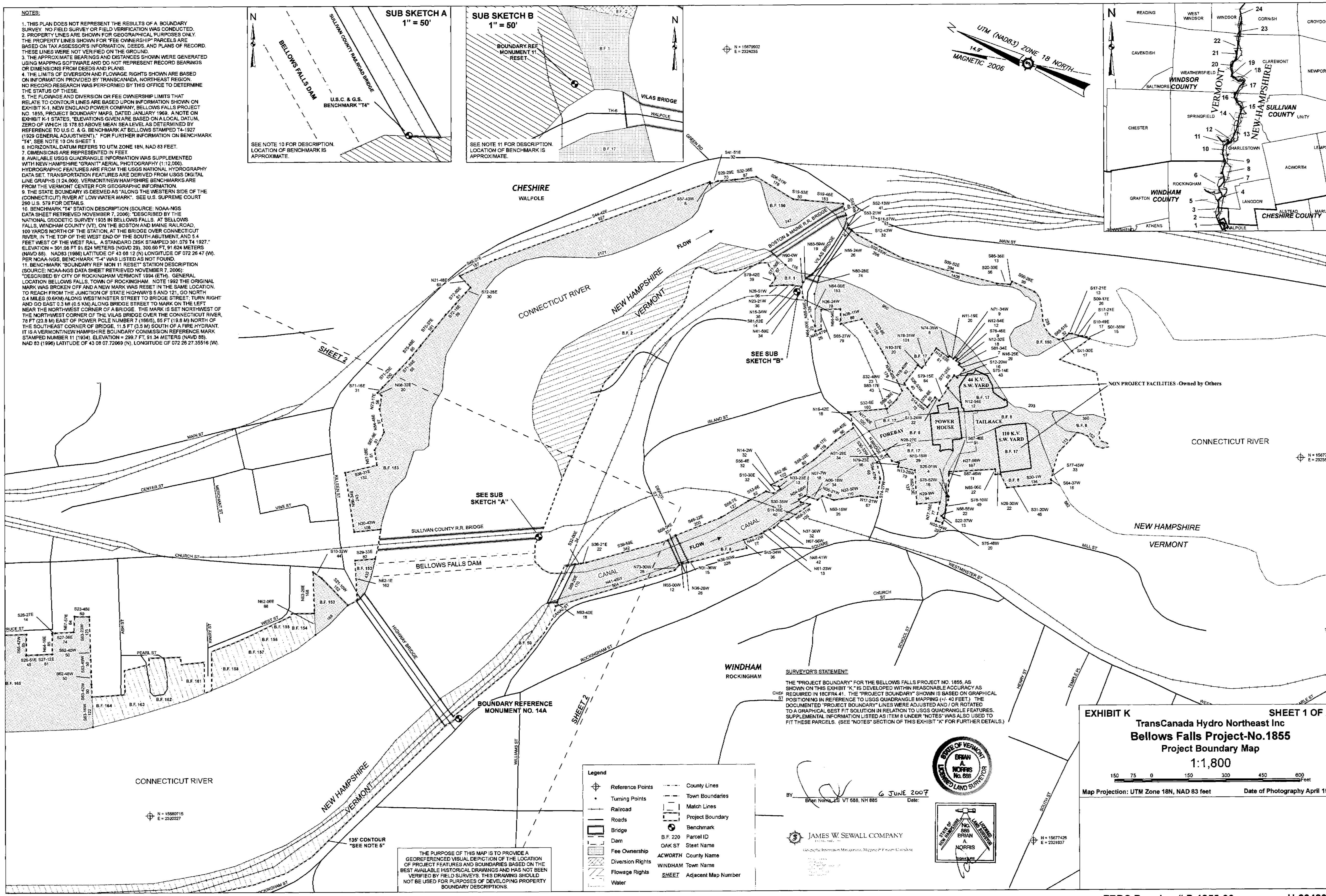
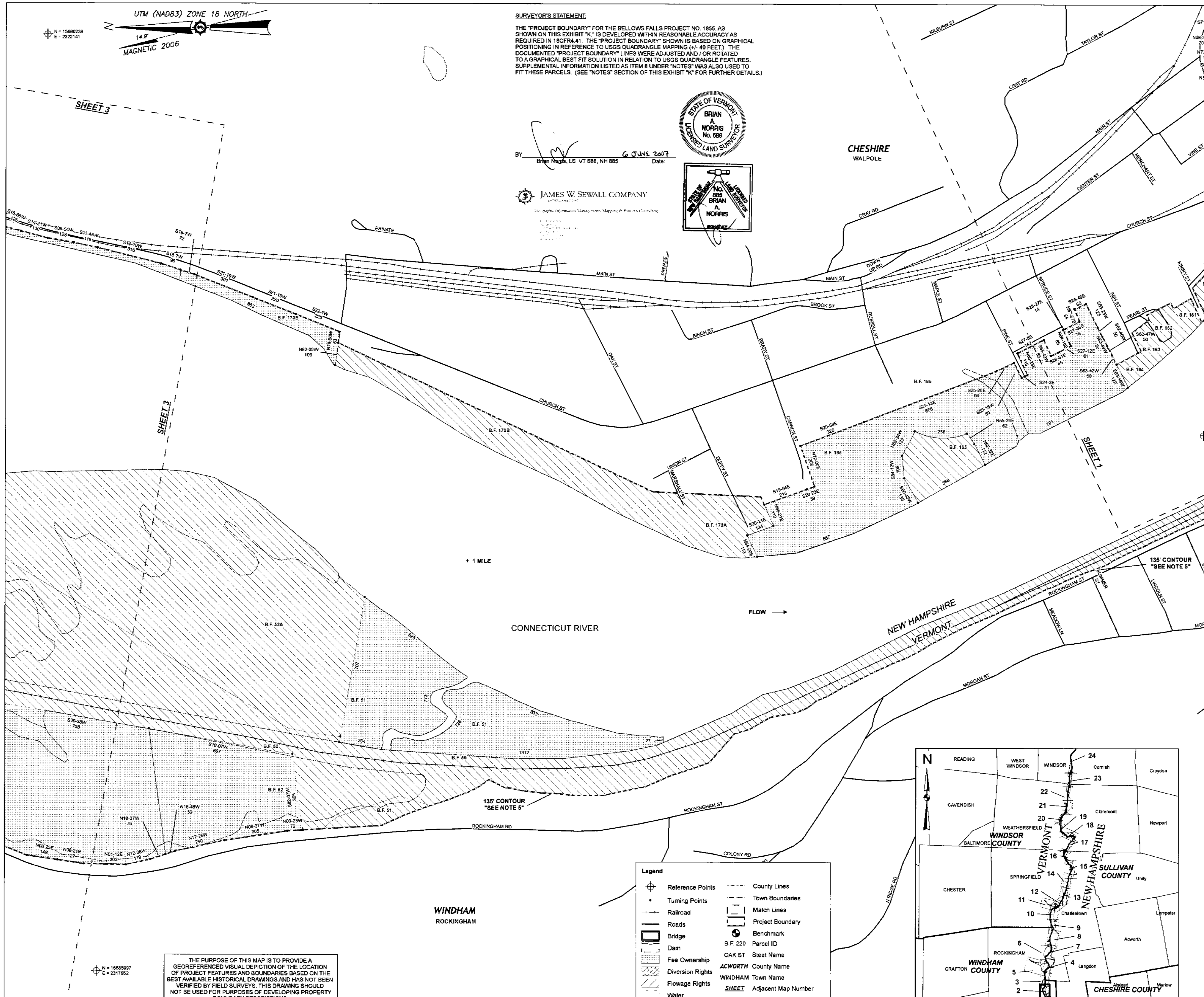


Non-Internet Public Material under 18 CFR §388.112

JAMES W. SEWALL COMPANY PROJECT NUMBER: 52060T

FERC Drawing # P-1855-99

H-204200



SURVEYOR'S STATEMENT:

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BY ____________ 6 JUNE 2007
Brian Norris, LS VT 688, NH 885 Date:

STATE OF VERMONT — BRIAN A. NORRIS No. 688 — LICENSED LAND SURVEYOR

JAMES W. SEWALL COMPANY

THE PURPOSE OF THIS MAP IS TO PROVIDE A GEOREFERENCED VISUAL DEPICTION OF THE LOCATION OF PROJECT FEATURES AND BOUNDARIES BASED ON THE BEST AVAILABLE HISTORICAL DRAWINGS AND HAS NOT BEEN VERIFIED BY FIELD SURVEYS. THIS DRAWING SHOULD NOT BE USED FOR PURPOSES OF DEVELOPING PROPERTY BOUNDARY DESCRIPTIONS.

NOTES:

1. THIS PLAN DOES NOT REPRESENT THE RESULTS OF A BOUNDARY SURVEY. NO FIELD SURVEY OR FIELD VERIFICATION WAS CONDUCTED.
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6. HORIZONTAL DATUM REFERS TO UTM ZONE 18N, NAD 83 FEET.
7. DIMENSIONS ARE REPRESENTED IN FEET.
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9. THE STATE BOUNDARY IS DEEMED AS "ALONG THE WESTERN SIDE OF THE (CONNECTICUT) RIVER AT LOW WATER MARK". SEE U.S. SUPREME COURT 290 U.S. 579 FOR DETAILS.

EXHIBIT K **SHEET 2 OF 24**

TransCanada Hydro Northeast Inc

Bellows Falls Project-No.1855

Project Boundary Map

1:2,400

200 100 0 200 400 600 800 Feet

Map Projection: UTM Zone 18N, NAD 83 feet — Date of Photography April 1998

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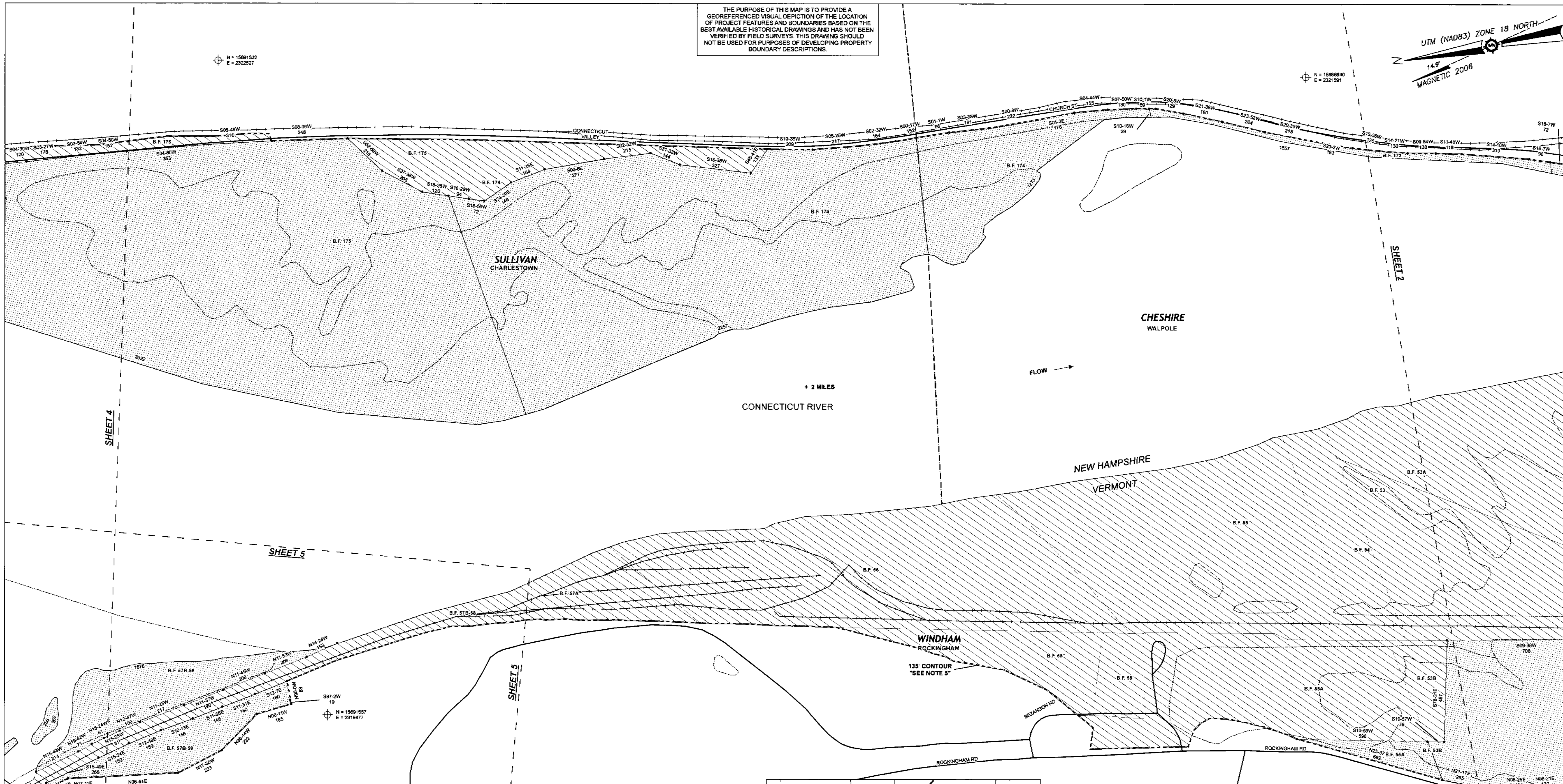

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SURVEYOR'S STATEMENT:

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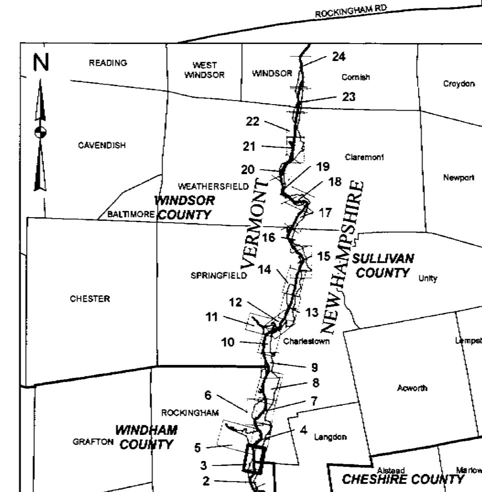
BY: Brian Norris, LS VT 688, NH 885 — Date: 6 JUNE 2007

STATE OF VERMONT — BRIAN A. NORRIS No. 688 — LICENSED LAND SURVEYOR

STATE OF NEW HAMPSHIRE — No. 885 BRIAN A. NORRIS — LICENSED LAND SURVEYOR

JAMES W. SEWALL COMPANY

Geographic Information Management, Mapping & Forestry Consulting



Legend

⊕	Reference Points		County Lines
•	Turning Points		Town Boundaries
	Railroad		Match Lines
	Roads		Project Boundary
	Bridge	B.F. 220	Parcel ID
	Dam	OAK ST	Steet Name
	Fee Ownership	*ACWORTH*	County Name
	Diversion Rights	WINDHAM	Town Name
	Flowage Rights	SHEET	Adjacent Map Number
	Water		

EXHIBIT K — **SHEET 3 OF 24**

TransCanada Hydro Northeast Inc

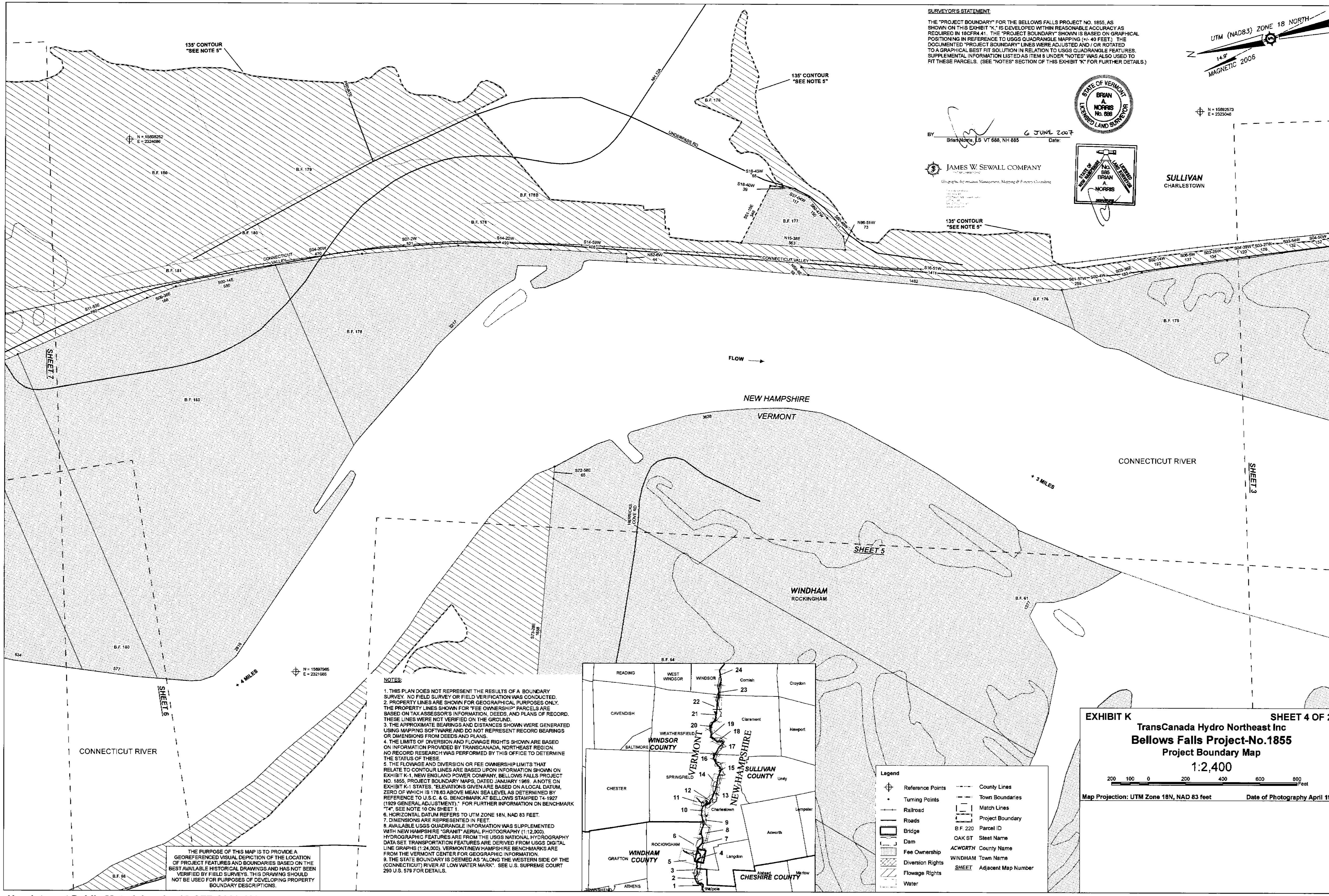
Bellows Falls Project-No.1855

Project Boundary Map

1:2,400

200 100 0 200 400 600 800 Feet

Map Projection: UTM Zone 18N, NAD 83 feet — Date of Photography April 1998



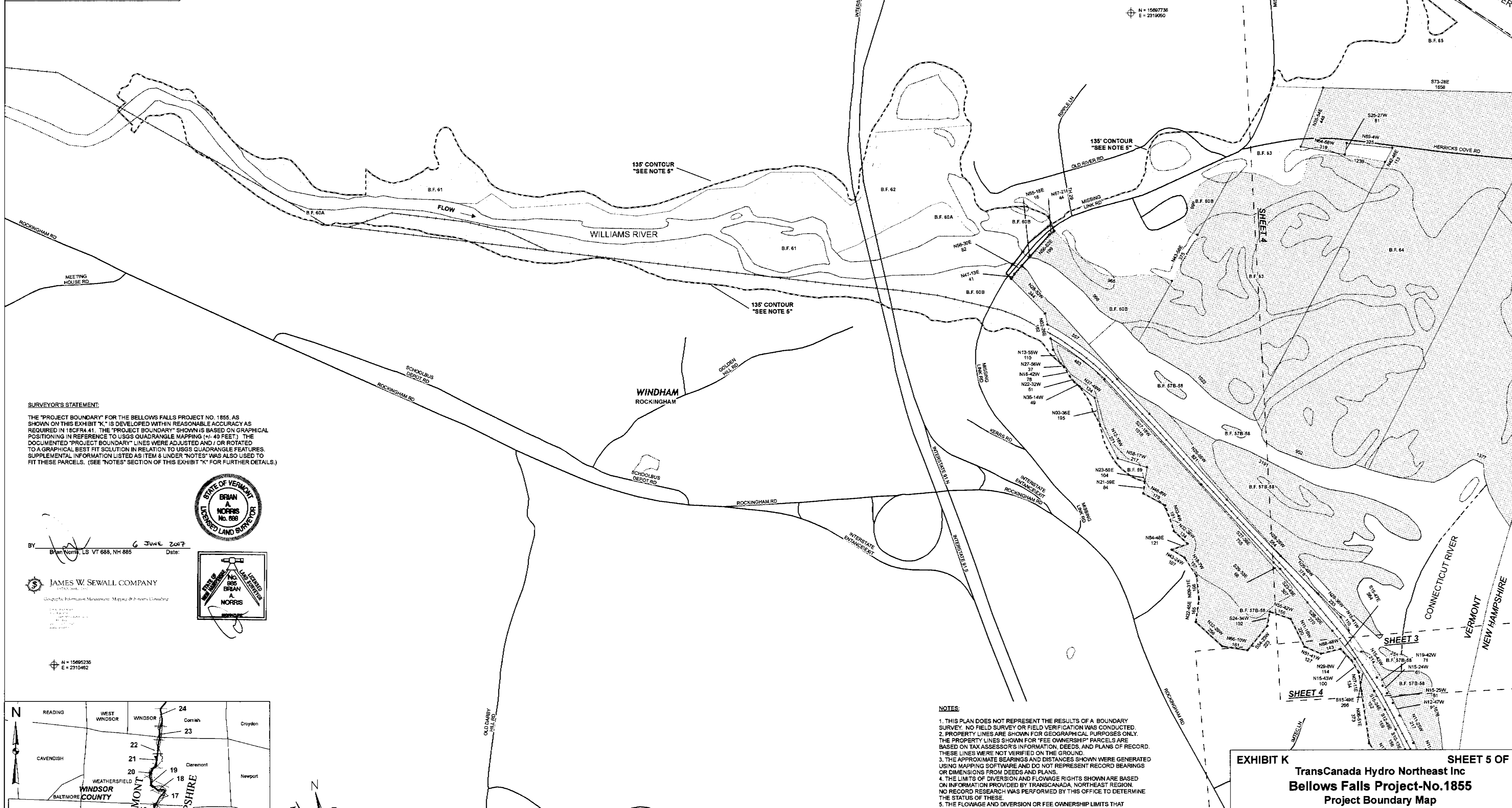
Non-Internet Public Material under 18 CFR §388.112

JAMES W. SEWALL COMPANY PROJECT NUMBER: 52060T

FERC Drawing # P-1855-102

H-204203

THE PURPOSE OF THIS MAP IS TO PROVIDE A GEOREFERENCED VISUAL DEPICTION OF THE LOCATION OF PROJECT FEATURES AND BOUNDARIES BASED ON THE BEST AVAILABLE HISTORICAL DRAWINGS AND HAS NOT BEEN VERIFIED BY FIELD SURVEYS. THIS DRAWING SHOULD NOT BE USED FOR PURPOSES OF DEVELOPING PROPERTY BOUNDARY DESCRIPTIONS.



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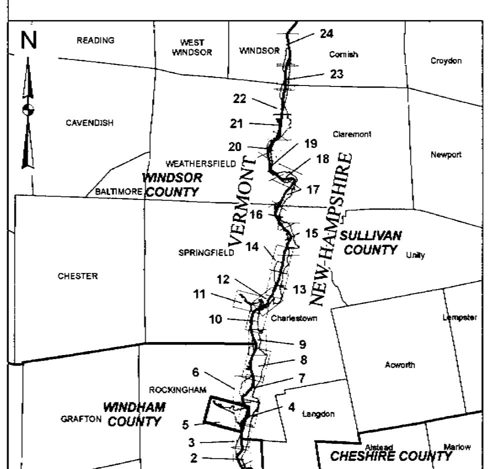
STATE OF VERMONT BRIAN A. NORRIS No. 688 LICENSED LAND SURVEYOR

BY ______ 6 JUNE 2007
Brian Norris, LS VT 688, NH 885 Date:

JAMES W. SEWALL COMPANY

STATE OF NEW HAMPSHIRE No. 885 BRIAN A. NORRIS LICENSED LAND SURVEYOR



Legend

⌖	Reference Points		County Lines
•	Turning Points		Town Boundaries
	Railroad		Match Lines
	Roads		Project Boundary
	Bridge	B.F. 220	Parcel ID
	Dam	OAK ST	Steet Name
	Fee Ownership	*ACWORTH*	County Name
	Diversion Rights	WINDHAM	Town Name
	Flowage Rights	SHEET	Adjacent Map Number
	Water		

NOTES:

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EXHIBIT K **SHEET 5 OF 24**

TransCanada Hydro Northeast Inc

Bellows Falls Project-No.1855

Project Boundary Map

1:3,600

300 150 0 300 600 900 1,200 Feet

Map Projection: UTM Zone 18N, NAD 83 feet — Date of Photography April 1998

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BY ______ 6 JUNE 2007
Brian Norris, LS VT 688, NH 885 Date:

STATE OF VERMONT LICENSED LAND SURVEYOR BRIAN A. NORRIS No. 688

STATE OF NEW HAMPSHIRE LICENSED LAND SURVEYOR No. 885 BRIAN A. NORRIS SIGNATURE

JAMES W. SEWALL COMPANY
Geographic Information Management, Mapping & Forestry Consulting

Legend			
	Reference Points		County Lines
	Turning Points		Town Boundaries
	Railroad		Match Lines
	Roads		Project Boundary
	Bridge	B.F. 220	Parcel ID
	Dam	OAK ST	Street Name
	Fee Ownership	ACWORTH	County Name
	Diversion Rights	WINDHAM	Town Name
	Flowage Rights	SHEET	Adjacent Map Number
	Water		

EXHIBIT K SHEET 6 OF 24

TransCanada Hydro Northeast Inc

Bellows Falls Project-No.1855

Project Boundary Map

1:2,400

200 100 0 200 400 600 800 Feet

Map Projection: UTM Zone 18N, NAD 83 feet — Date of Photography April 1998

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Non-Internet Public Material under 18 CFR §388.112

JAMES W. SEWALL COMPANY PROJECT NUMBER: 52060T

FERC Drawing # P-1855-104 **H-204205**

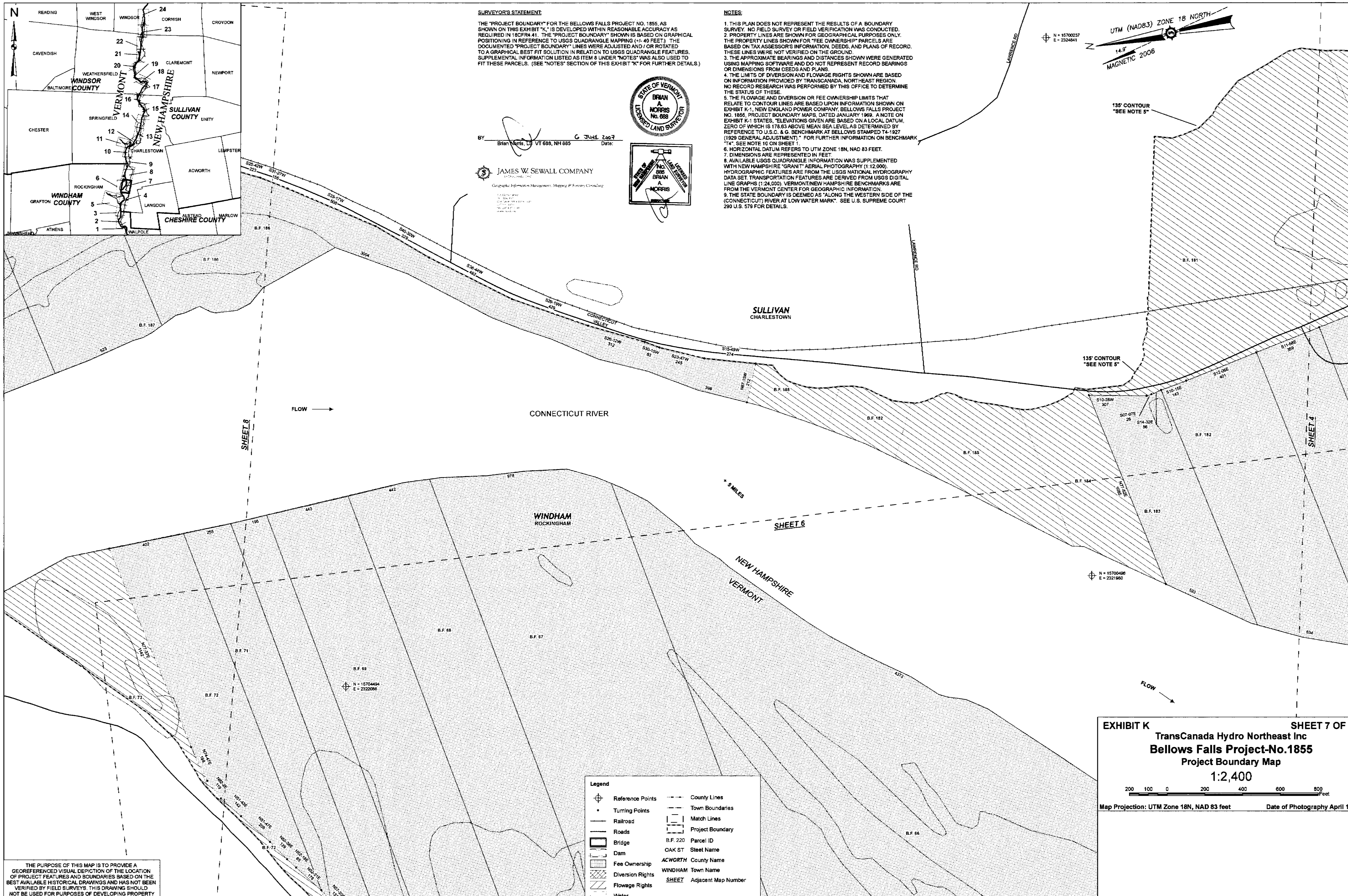

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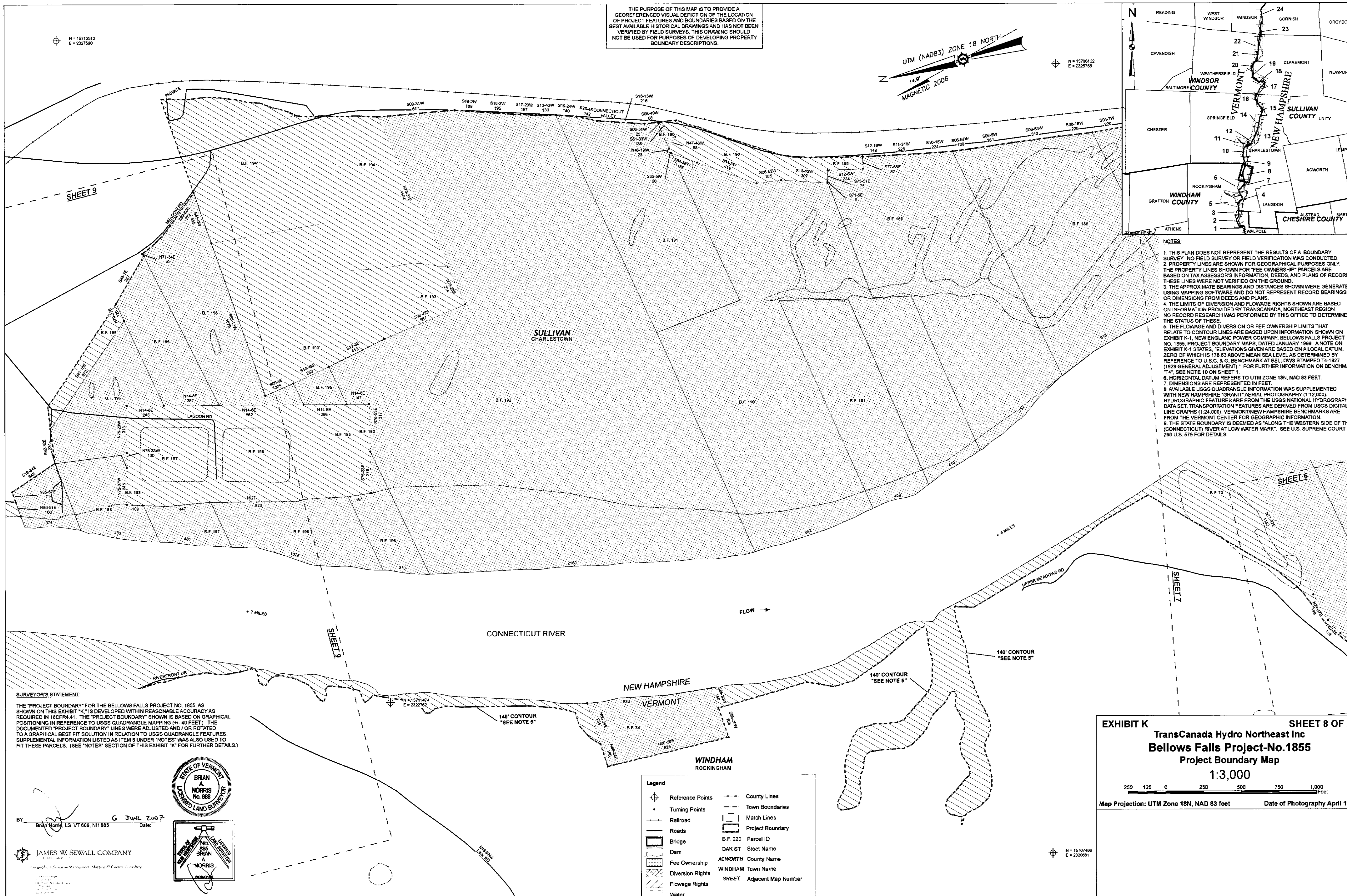
EXHIBIT K SHEET 7 OF 24
TransCanada Hydro Northeast Inc
Bellows Falls Project-No.1855
Project Boundary Map
1:2,400
Map Projection: UTM Zone 18N, NAD 83 feet
Date of Photography April 1998



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THE "PROJECT BOUNDARY" FOR THE BELLOWS FALLS PROJECT NO. 1855, AS SHOWN ON THIS EXHIBIT "K," IS DEVELOPED WITHIN REASONABLE ACCURACY AS REQUIRED IN 18CFR4.41. THE "PROJECT BOUNDARY" SHOWN IS BASED ON GRAPHICAL POSITIONING IN REFERENCE TO USGS QUADRANGLE MAPPING (+/- 40 FEET.) THE DOCUMENTED "PROJECT BOUNDARY" LINES WERE ADJUSTED AND / OR ROTATED TO A GRAPHICAL BEST FIT SOLUTION IN RELATION TO USGS QUADRANGLE FEATURES. SUPPLEMENTAL INFORMATION LISTED AS ITEM 8 UNDER "NOTES" WAS ALSO USED TO FIT THESE PARCELS. (SEE "NOTES" SECTION OF THIS EXHIBIT "K" FOR FURTHER DETAILS.)

BY Brian Norris, LS VT 688, NH 885 Date: 6 JUNE 2007

JAMES W. SEWALL COMPANY

Legend

Reference Points	County Lines
Turning Points	Town Boundaries
Railroad	Match Lines
Roads	Project Boundary
Bridge	B.F. 220 Parcel ID
Dam	OAK ST Steet Name
Fee Ownership	ACWORTH County Name
Diversion Rights	WINDHAM Town Name
Flowage Rights	SHEET Adjacent Map Number
Water	

EXHIBIT K SHEET 8 OF 24

TransCanada Hydro Northeast Inc

Bellows Falls Project-No.1855

Project Boundary Map

1:3,000

250 125 0 250 500 750 1,000 Feet

Map Projection: UTM Zone 18N, NAD 83 feet — Date of Photography April 1998

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BY ____________ 6 JUNE 2007
Brian Norris, LS VT 688, NH 885 Date:

STATE OF VERMONT BRIAN A. NORRIS No. 688 LICENSED LAND SURVEYOR

STATE OF NEW HAMPSHIRE No. 885 BRIAN A. NORRIS LICENSED LAND SURVEYOR

JAMES W. SEWALL COMPANY

NOTES:

1. THIS PLAN DOES NOT REPRESENT THE RESULTS OF A BOUNDARY SURVEY. NO FIELD SURVEY OR FIELD VERIFICATION WAS CONDUCTED.
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8. AVAILABLE USGS QUADRANGLE INFORMATION WAS SUPPLEMENTED WITH NEW HAMPSHIRE "GRANIT" AERIAL PHOTOGRAPHY (1:12,000). HYDROGRAPHIC FEATURES ARE FROM THE USGS NATIONAL HYDROGRAPHY DATA SET. TRANSPORTATION FEATURES ARE DERIVED FROM USGS DIGITAL LINE GRAPHS (1:24,000). VERMONT/NEW HAMPSHIRE BENCHMARKS ARE FROM THE VERMONT CENTER FOR GEOGRAPHIC INFORMATION.
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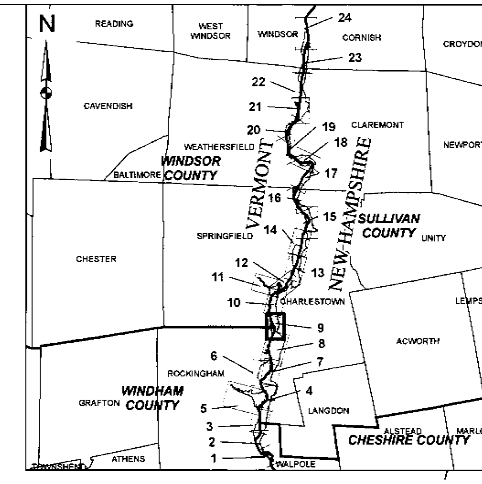

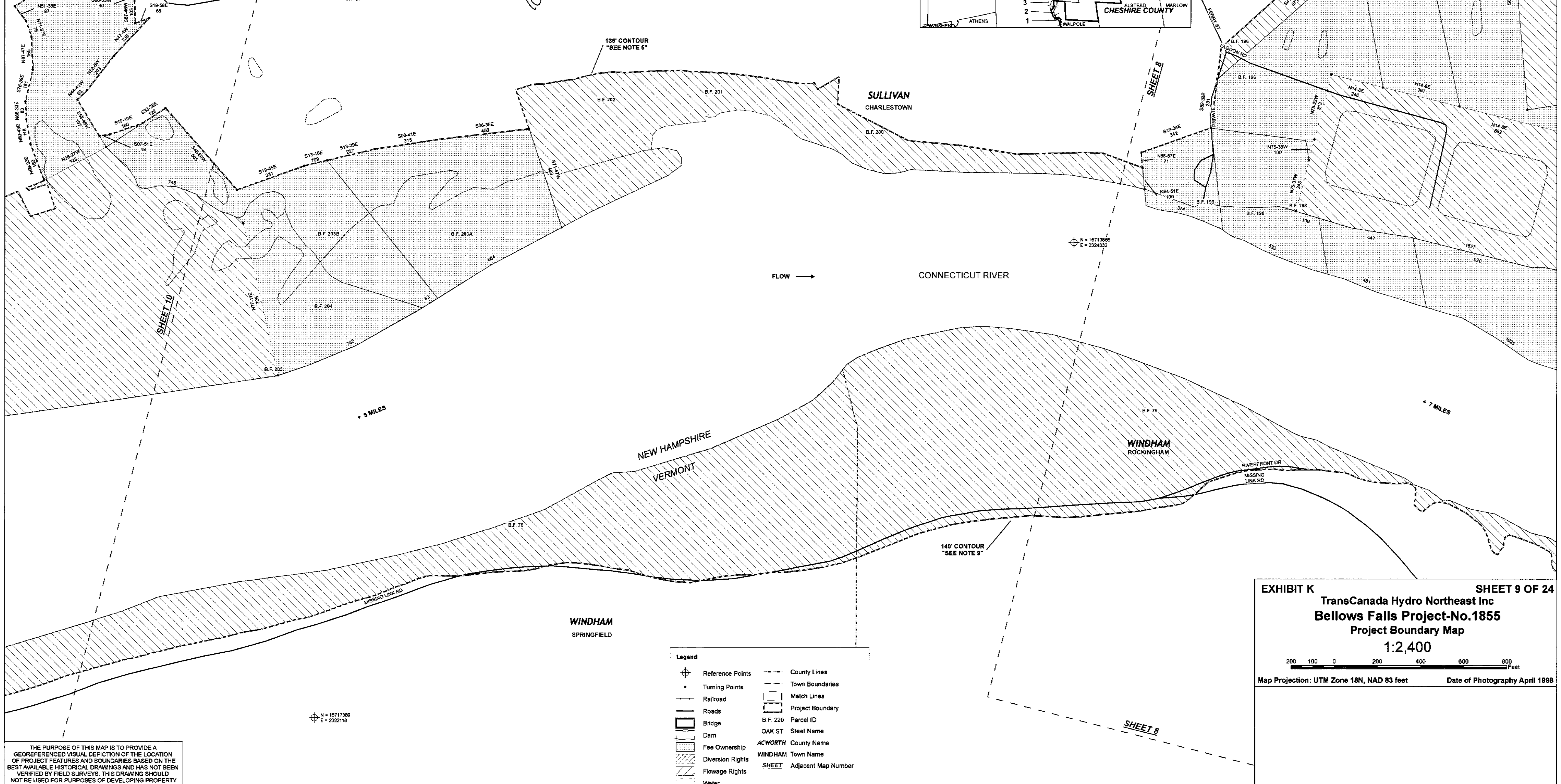

Legend

Reference Points	County Lines
Turning Points	Town Boundaries
Railroad	Match Lines
Roads	Project Boundary
Bridge	B.F. 220 Parcel ID
Dam	OAK ST Steel Name
Fee Ownership	*ACWORTH* County Name
Diversion Rights	WINDHAM Town Name
Flowage Rights	*SHEET* Adjacent Map Number
Water	

THE PURPOSE OF THIS MAP IS TO PROVIDE A GEOREFERENCED VISUAL DEPICTION OF THE LOCATION OF PROJECT FEATURES AND BOUNDARIES BASED ON THE BEST AVAILABLE HISTORICAL DRAWINGS AND HAS NOT BEEN VERIFIED BY FIELD SURVEYS. THIS DRAWING SHOULD NOT BE USED FOR PURPOSES OF DEVELOPING PROPERTY BOUNDARY DESCRIPTIONS.

EXHIBIT K **SHEET 9 OF 24**

TransCanada Hydro Northeast Inc

Bellows Falls Project-No.1855

Project Boundary Map

1:2,400

200 100 0 200 400 600 800 Feet

Map Projection: UTM Zone 18N, NAD 83 feet — Date of Photography April 1998

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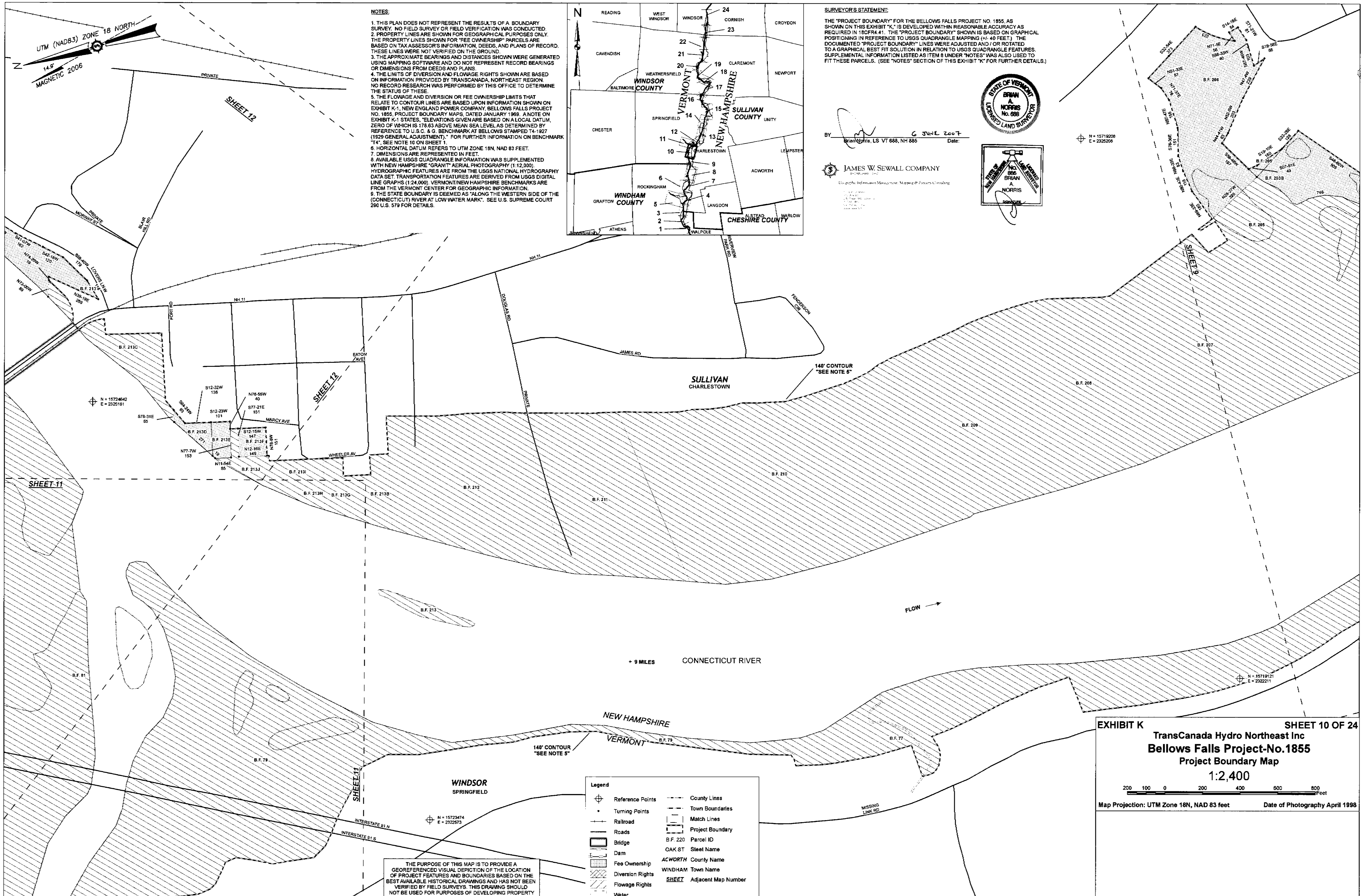
BY Brian Norris, LS VT 688, NH 886 Date: 6 JUNE 2007

JAMES W. SEWALL COMPANY

STATE OF VERMONT BRIAN A. NORRIS No. 688 LICENSED LAND SURVEYOR



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Legend

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Turning Points	Town Boundaries
Railroad	Match Lines
Roads	Project Boundary
Bridge	B.F. 220 Parcel ID
Dam	OAK ST Steet Name
Fee Ownership	*ACWORTH* County Name
Diversion Rights	WINDHAM Town Name
Flowage Rights	*SHEET* Adjacent Map Number
Water	

EXHIBIT K SHEET 10 OF 24

TransCanada Hydro Northeast Inc

Bellows Falls Project-No.1855

Project Boundary Map

1:2,400

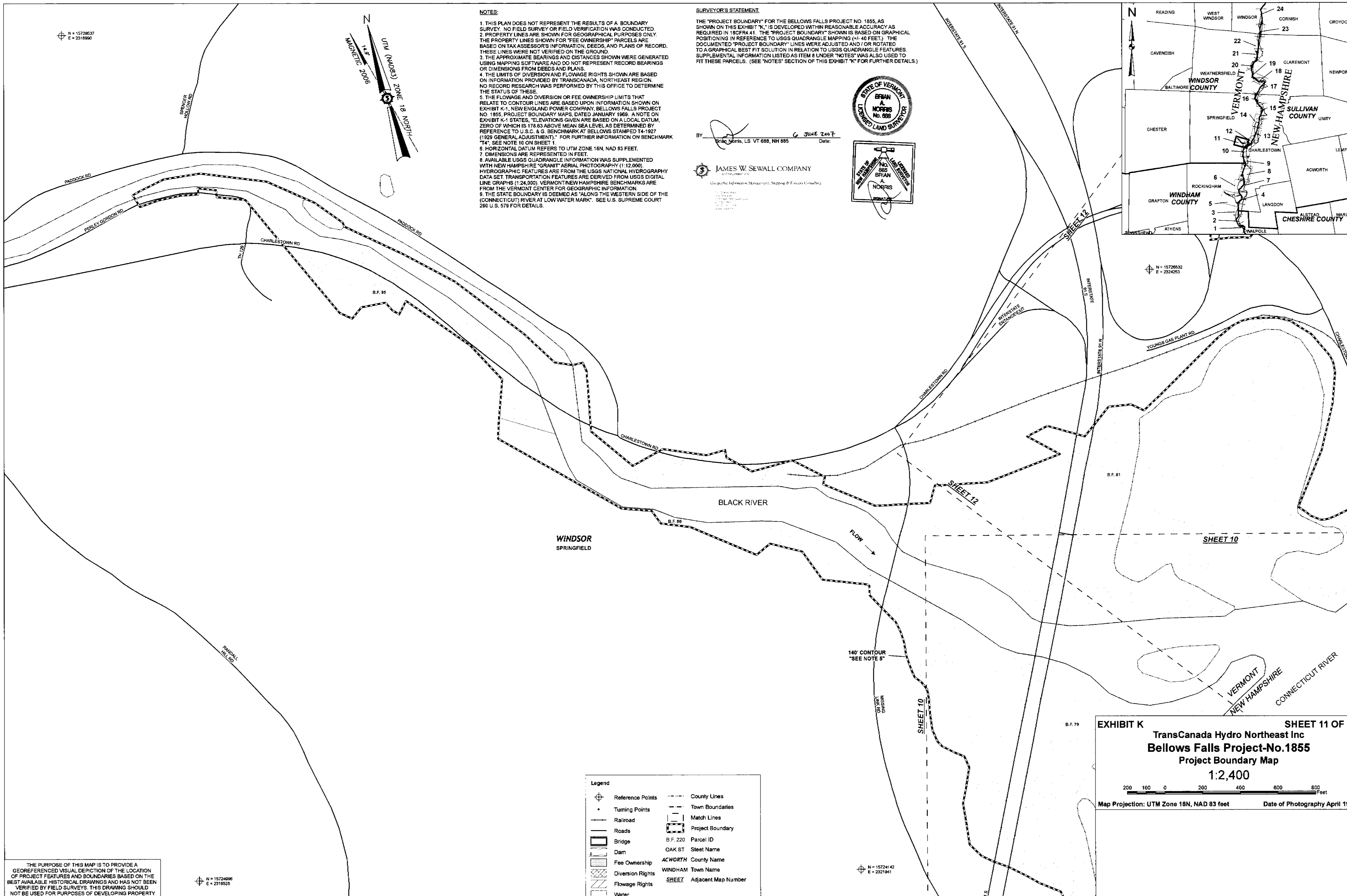
200 100 0 200 400 600 800 Feet

Map Projection: UTM Zone 18N, NAD 83 feet — Date of Photography April 1998

Non-Internet Public Material under 18 CFR §388.112

JAMES W. SEWALL COMPANY PROJECT NUMBER: 52060T

FERC Drawing # P-1855-108 **H-204209**

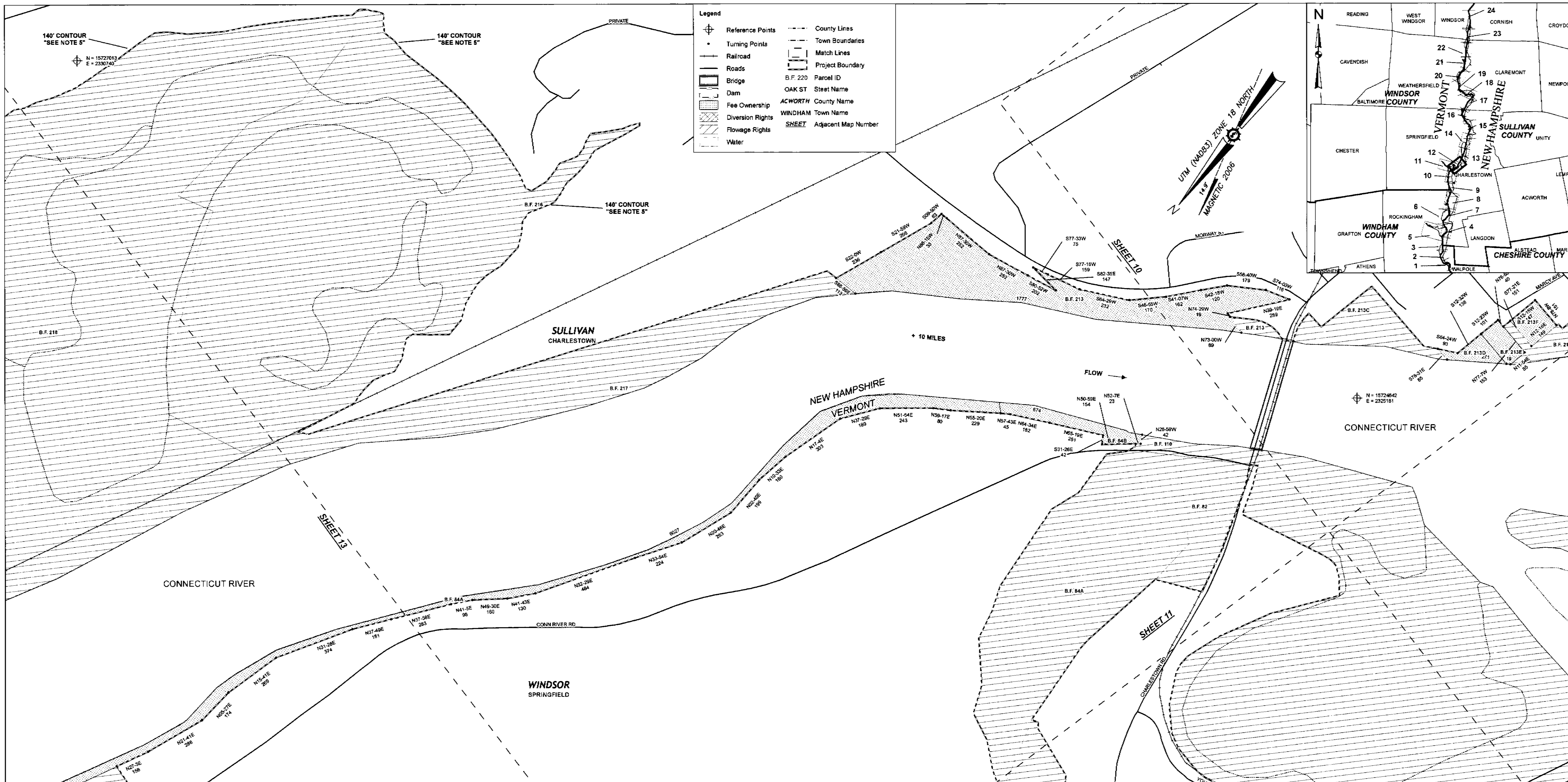


Non-Internet Public Material under 18 CFR §388.112

JAMES W. SEWALL COMPANY PROJECT NUMBER: 52060T

FERC Drawing # P-1855-109

H-204210



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BY ____________ 6 JUNE 2007
Brian Norris, LS VT 688, NH 885 Date:

STATE OF VERMONT BRIAN A. NORRIS No. 688 LICENSED LAND SURVEYOR

STATE OF NEW HAMPSHIRE No. 885 BRIAN A. NORRIS LICENSED LAND SURVEYOR

JAMES W. SEWALL COMPANY
Geographic Information Management, Mapping & Forestry Consulting

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EXHIBIT K SHEET 12 OF 24

TransCanada Hydro Northeast Inc

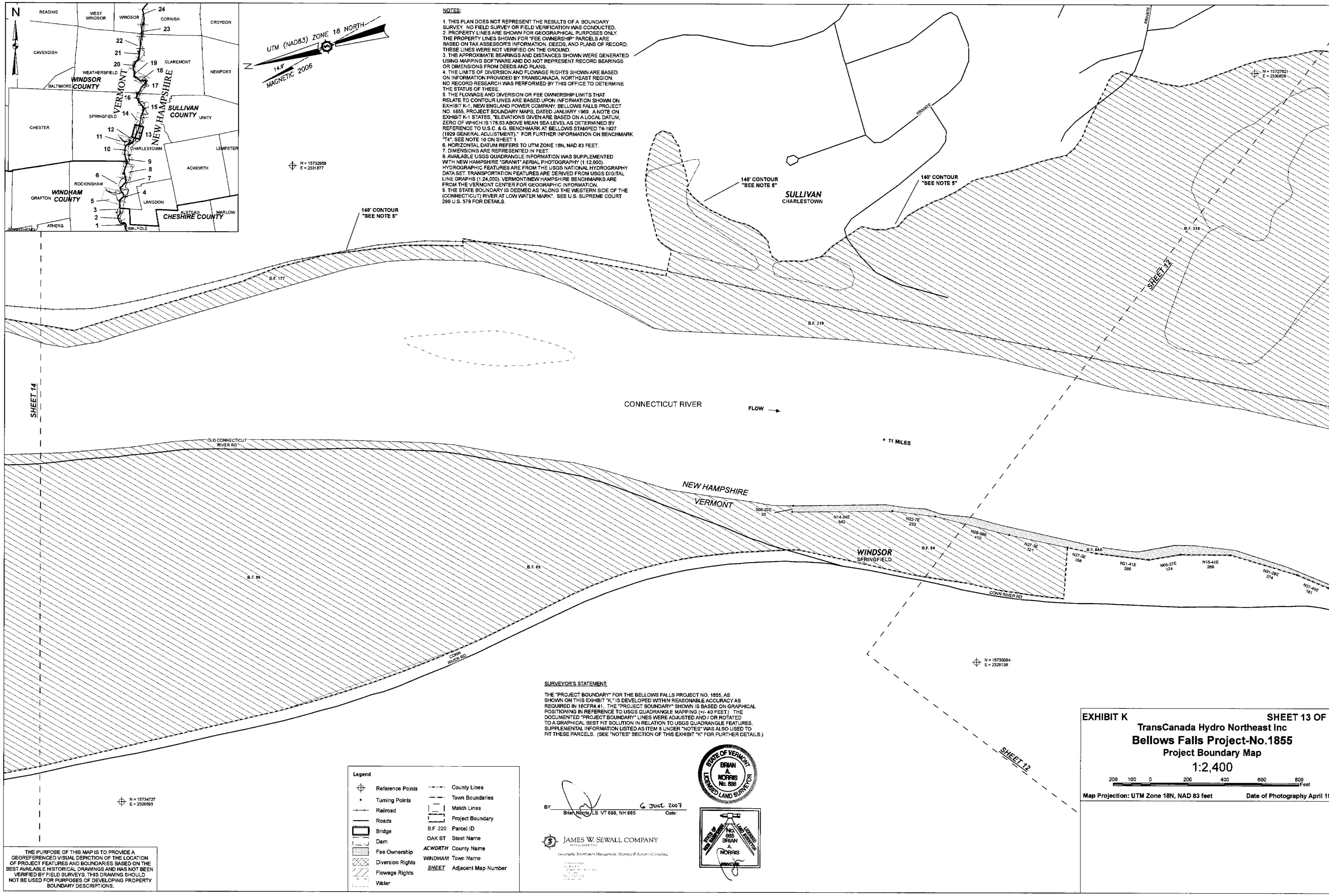
Bellows Falls Project-No.1855

Project Boundary Map

1:2,400

200 100 0 200 400 600 800 Feet

Map Projection: UTM Zone 18N, NAD 83 feet — Date of Photography April 1998



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BY Brian Norris LS VT 688, NH 885 — 6 JUNE 2007 Date:

JAMES W. SEWALL COMPANY

STATE OF VERMONT BRIAN A. NORRIS No. 688 LICENSED LAND SURVEYOR

STATE OF NEW HAMPSHIRE NO. 885 BRIAN A. NORRIS LICENSED LAND SURVEYOR

Legend

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Turning Points	Town Boundaries
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Water	

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EXHIBIT K — SHEET 13 OF 24

TransCanada Hydro Northeast Inc

Bellows Falls Project-No.1855

Project Boundary Map

1:2,400

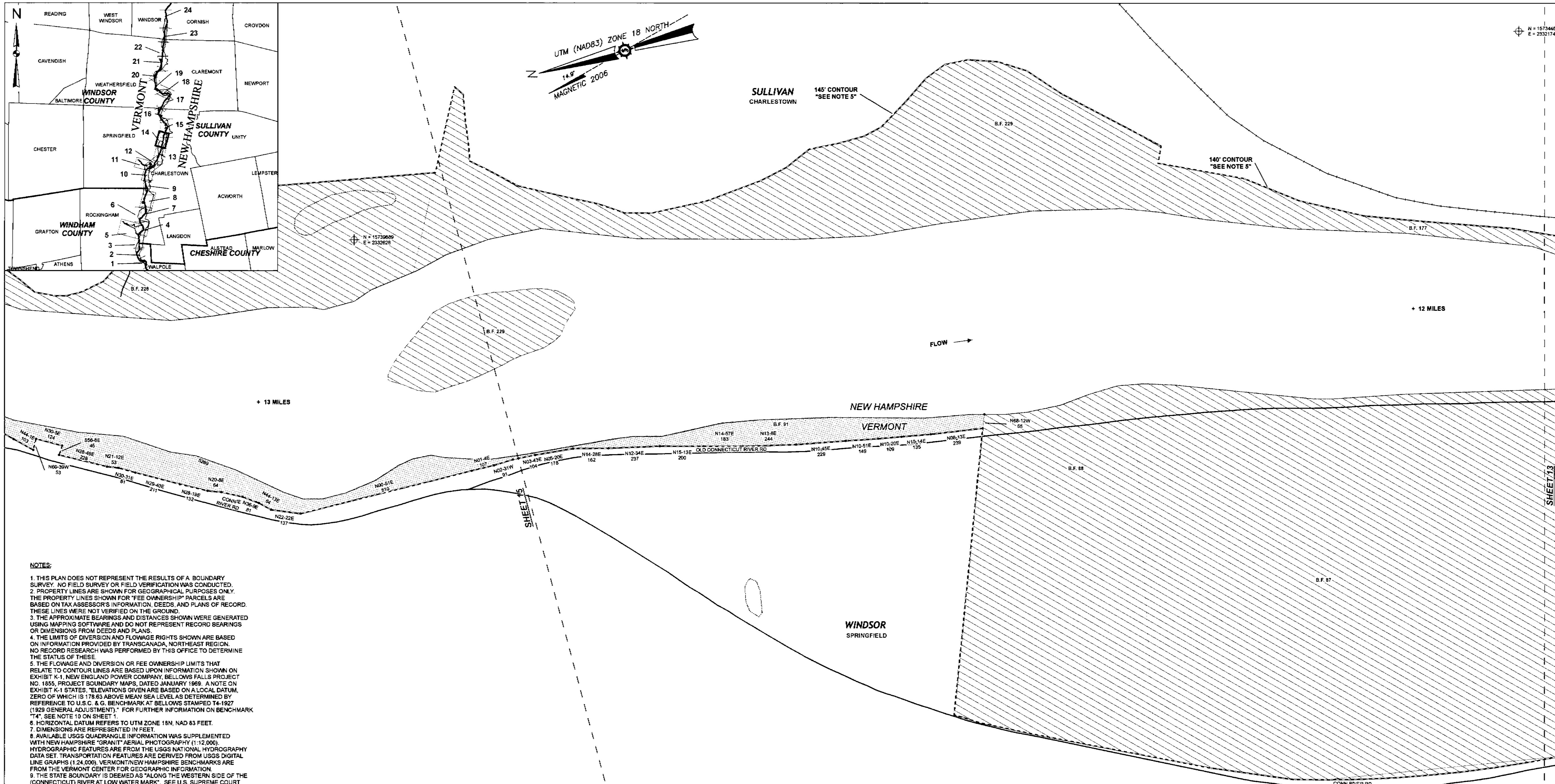
200 100 0 200 400 600 800 Feet

Map Projection: UTM Zone 18N, NAD 83 feet — Date of Photography April 1998

Non-Internet Public Material under 18 CFR §388.112

JAMES W. SEWALL COMPANY PROJECT NUMBER: 52060T

FERC Drawing # P-1855-111 **H-204212**



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BY Brian Norris LS VT 688, NH 885 — Date: 6 JUNE 2007

STATE OF VERMONT — BRIAN A. NORRIS No. 688 — LICENSED LAND SURVEYOR

STATE OF NEW HAMPSHIRE — BRIAN A. NORRIS No. 885 — LICENSED LAND SURVEYOR

JAMES W. SEWALL COMPANY

Legend

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Dam	OAK ST Steet Name
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Flowage Rights	SHEET Adjacent Map Number
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EXHIBIT K — SHEET 14 OF 24

TransCanada Hydro Northeast Inc

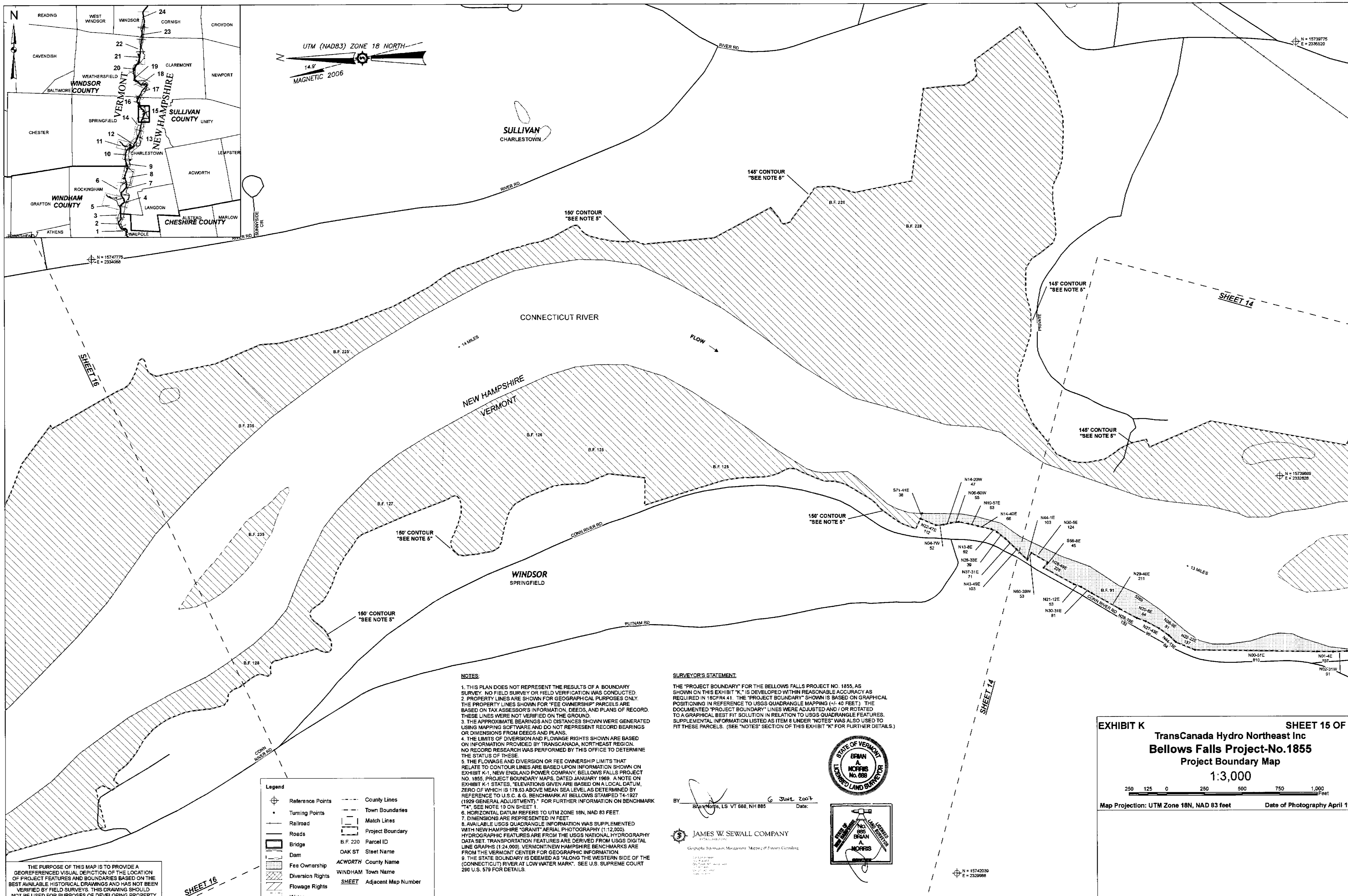
Bellows Falls Project-No.1855

Project Boundary Map

1:2,400

200 100 0 200 400 600 800 Feet

Map Projection: UTM Zone 18N, NAD 83 feet — Date of Photography April 1998



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SURVEYOR'S STATEMENT:

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BY Brian Norris, LS VT 688, NH 885 Date: 6 JUNE 2007

STATE OF VERMONT BRIAN A. NORRIS No. 688 LICENSED LAND SURVEYOR

STATE OF NEW HAMPSHIRE No. 885 BRIAN A. NORRIS LICENSED LAND SURVEYOR

JAMES W. SEWALL COMPANY

Geographic Information Management Mapping & Forestry Consulting

EXHIBIT K SHEET 15 OF 24

TransCanada Hydro Northeast Inc

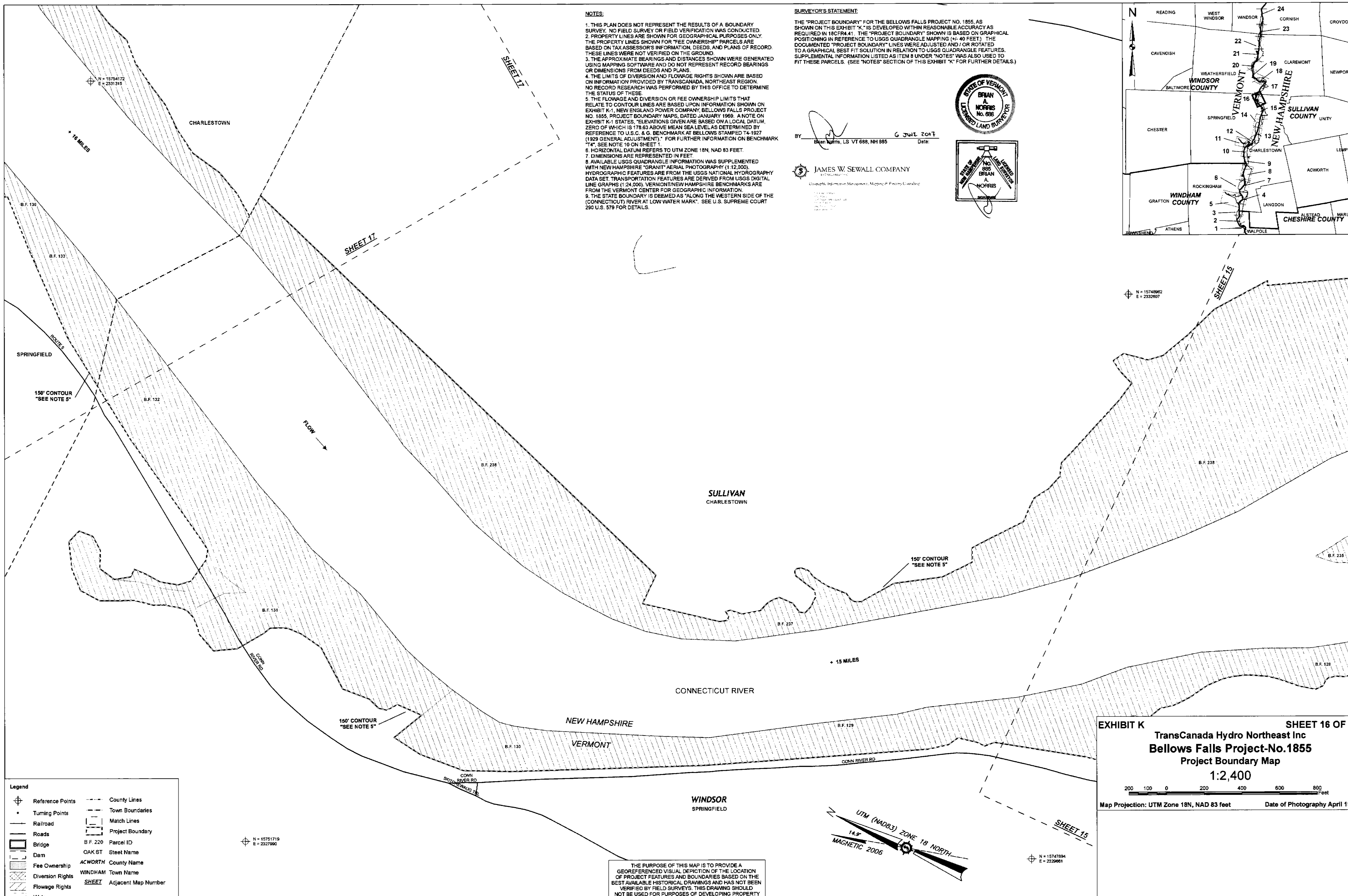
Bellows Falls Project-No.1855

Project Boundary Map

1:3,000

250 125 0 250 500 750 1,000 Feet

Map Projection: UTM Zone 18N, NAD 83 feet Date of Photography April 1998



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BY: Brian Norris, LS VT 688, NH 885 Date: 6 JUNE 2007

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STATE OF NEW HAMPSHIRE No. 885 BRIAN A. NORRIS LICENSED LAND SURVEYOR

JAMES W. SEWALL COMPANY

Geographic Information Management, Mapping & Forestry Consulting

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EXHIBIT K — SHEET 16 OF 24

TransCanada Hydro Northeast Inc

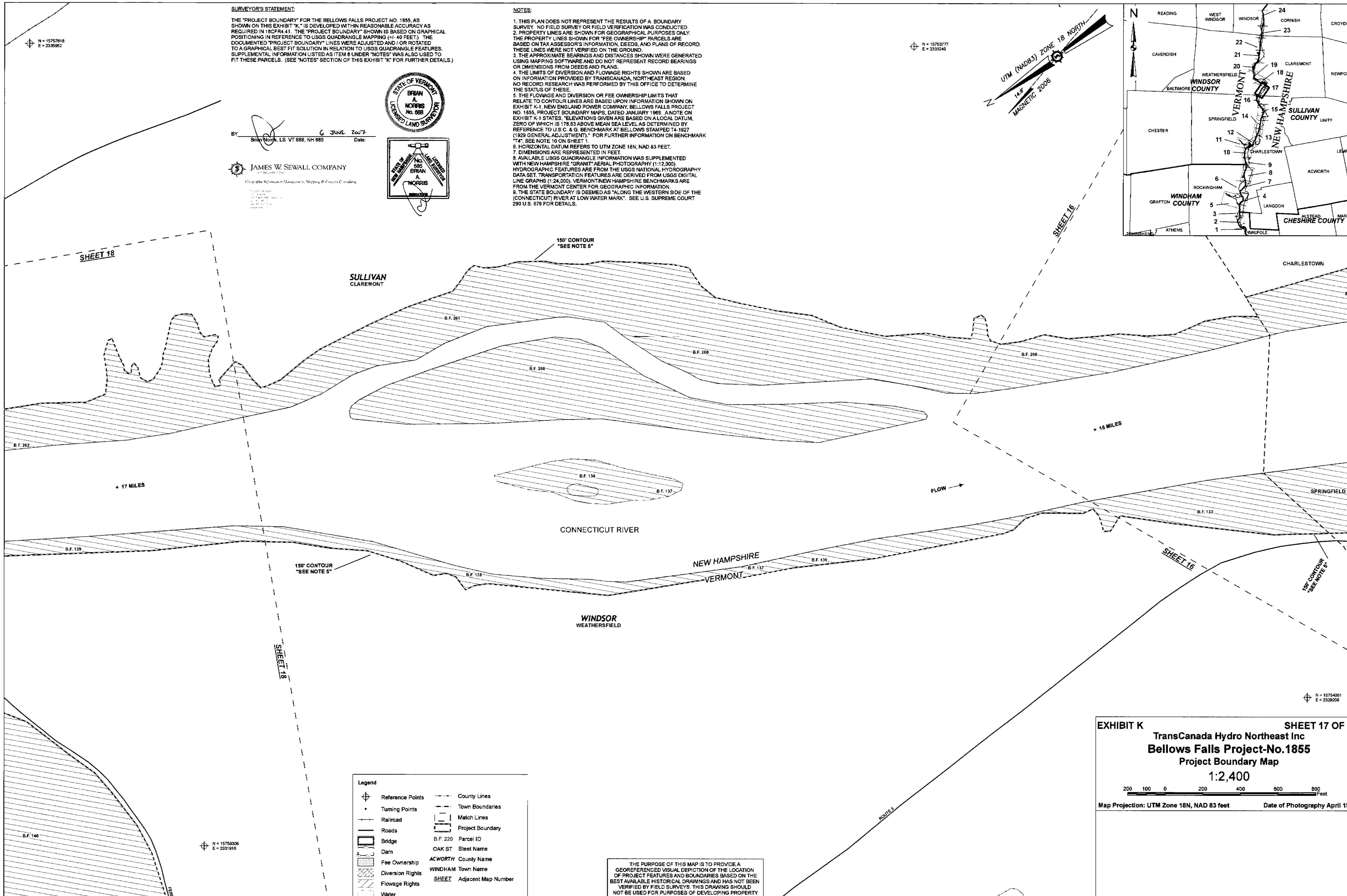
Bellows Falls Project-No.1855

Project Boundary Map

1:2,400

200 100 0 200 400 600 800 Feet

Map Projection: UTM Zone 18N, NAD 83 feet — Date of Photography April 1998



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BY ______ 6 JUNE 2007
Brian Norris, LS VT 688, NH 885 Date:

STATE OF VERMONT BRIAN A. NORRIS No. 688 LICENSED LAND SURVEYOR

STATE OF NEW HAMPSHIRE No. 885 BRIAN A. NORRIS LICENSED LAND SURVEYOR

JAMES W. SEWALL COMPANY

Geographic Information Management, Mapping & Forestry Consulting

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Legend

Reference Points	County Lines
Turning Points	Town Boundaries
Railroad	Match Lines
Roads	Project Boundary
Bridge	B.F. 220 Parcel ID
Dam	OAK ST Steet Name
Fee Ownership	*ACWORTH* County Name
Diversion Rights	WINDHAM Town Name
Flowage Rights	*SHEET* Adjacent Map Number
Water	

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EXHIBIT K **SHEET 17 OF 24**

TransCanada Hydro Northeast Inc

Bellows Falls Project-No.1855

Project Boundary Map

1:2,400

200 100 0 200 400 600 800 Feet

Map Projection: UTM Zone 18N, NAD 83 feet **Date of Photography April 1998**

SURVEYOR'S STATEMENT:

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BY ____________ 6 JUNE 2007
Brian Norris, LS VT 688, NH 885 Date:

STATE OF VERMONT BRIAN A. NORRIS No. 688 LICENSED LAND SURVEYOR

STATE OF NEW HAMPSHIRE NO. 885 BRIAN A. NORRIS LICENSED LAND SURVEYOR SIGNATURE

JAMES W. SEWALL COMPANY

Geographic Information Management, Mapping & Forestry Consulting

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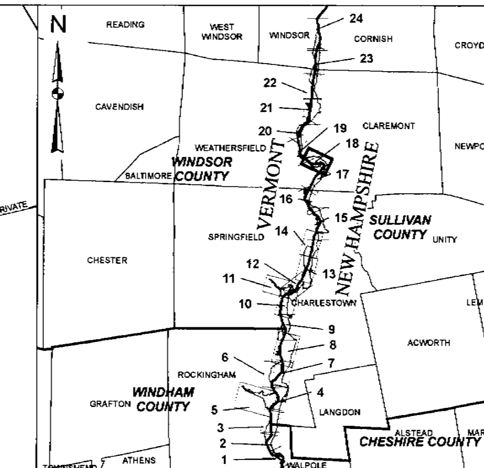

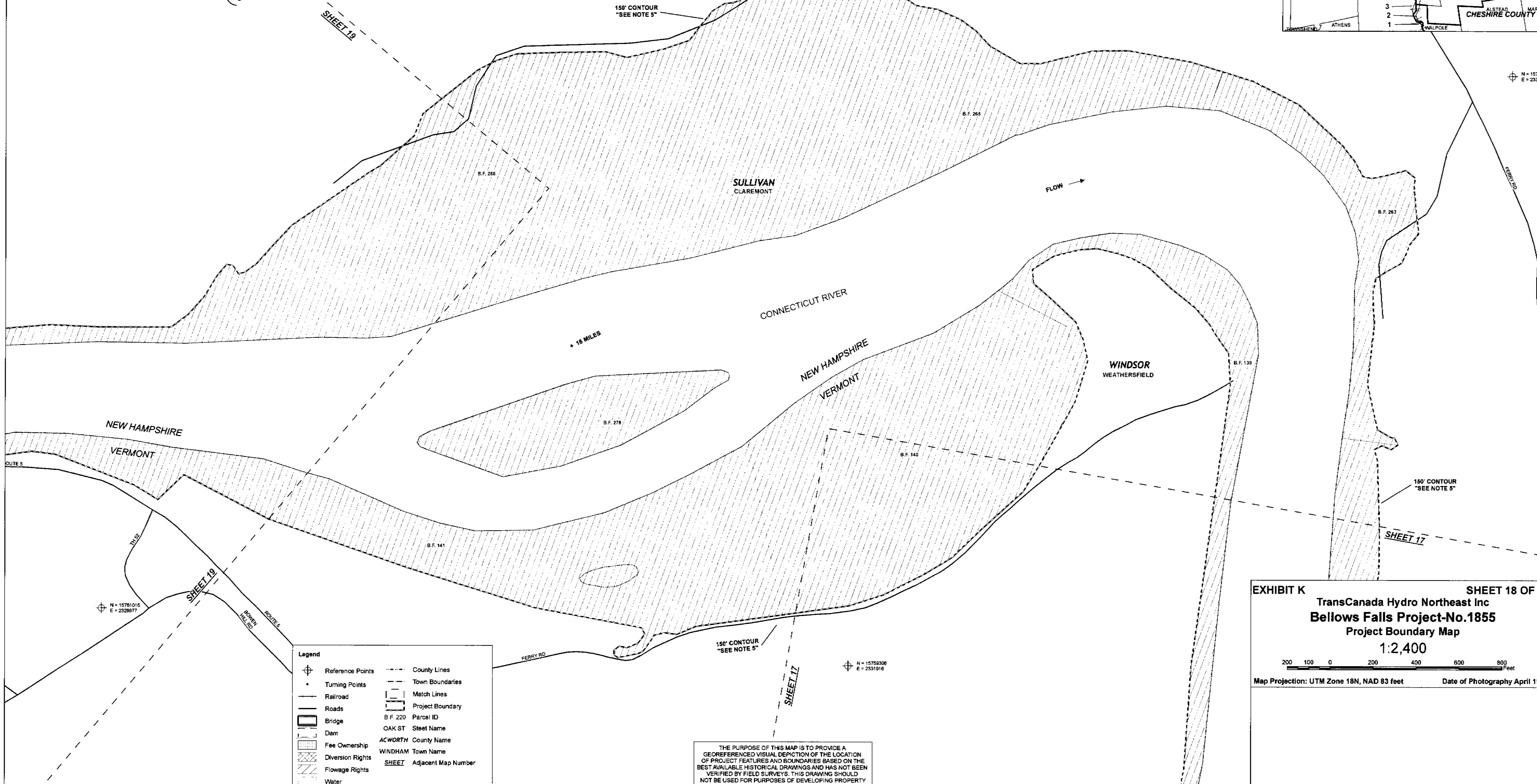

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EXHIBIT K SHEET 18 OF 24

TransCanada Hydro Northeast Inc

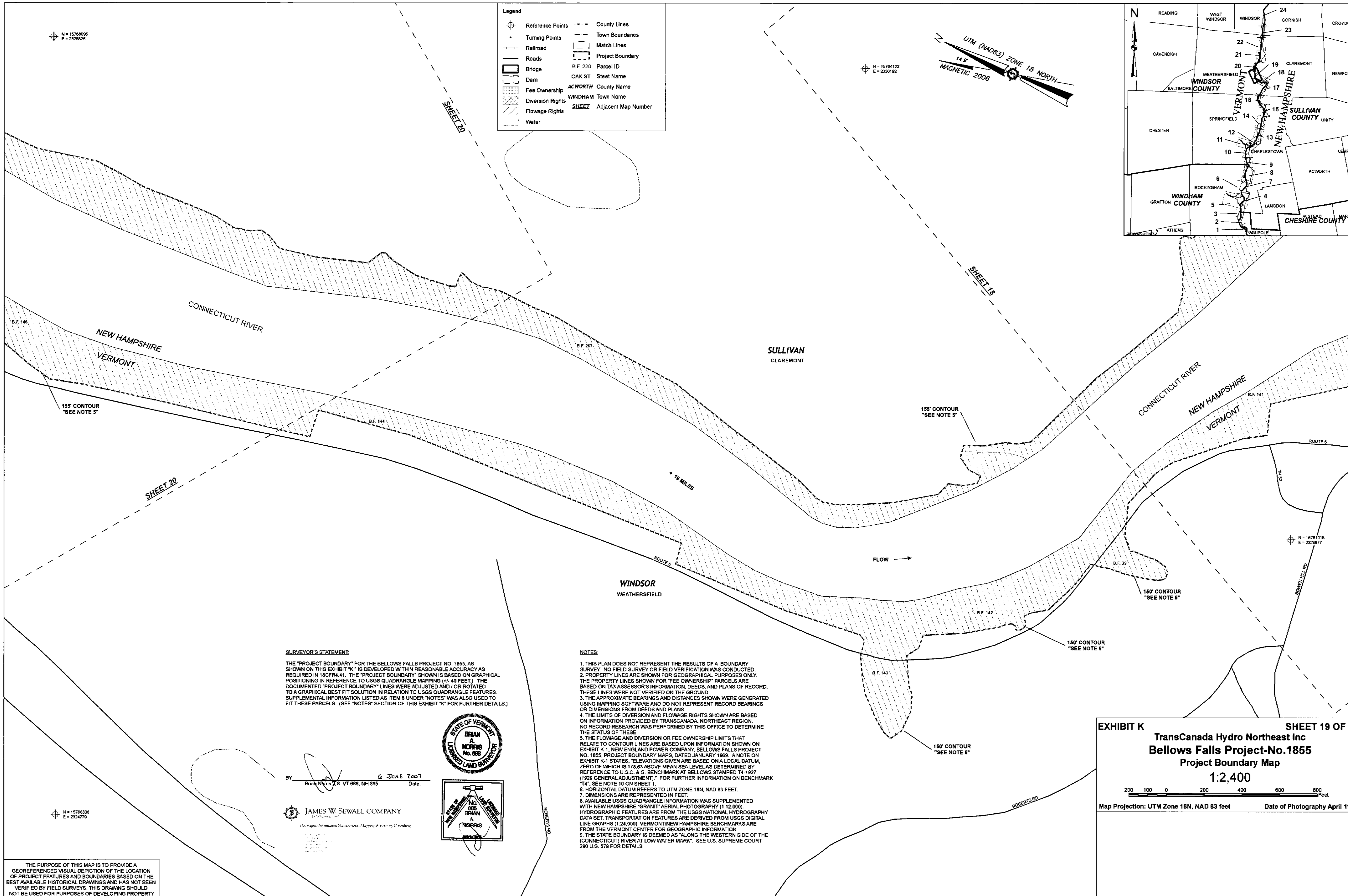
Bellows Falls Project-No.1855

Project Boundary Map

1:2,400

200 100 0 200 400 600 800 Feet

Map Projection: UTM Zone 18N, NAD 83 feet — Date of Photography April 1998



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STATE OF VERMONT BRIAN A. NORRIS No. 688 LICENSED LAND SURVEYOR

BY ______ 6 JUNE 2007
Brian Norris, LS VT 688, NH 885 Date:

STATE OF NEW HAMPSHIRE BRIAN A. NORRIS No. 885 LICENSED LAND SURVEYOR

JAMES W. SEWALL COMPANY

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EXHIBIT K — SHEET 19 OF 24

TransCanada Hydro Northeast Inc

Bellows Falls Project-No.1855

Project Boundary Map

1:2,400

200 100 0 200 400 600 800 Feet

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JAMES W. SEWALL COMPANY

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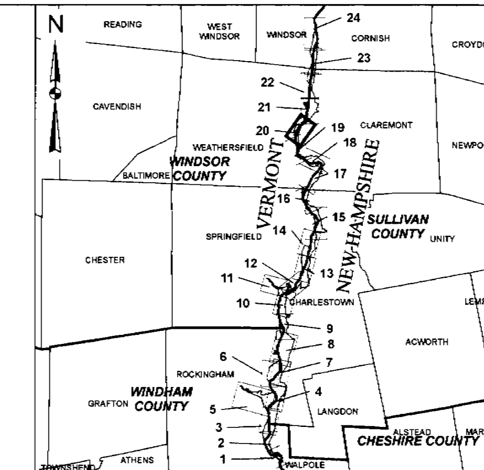

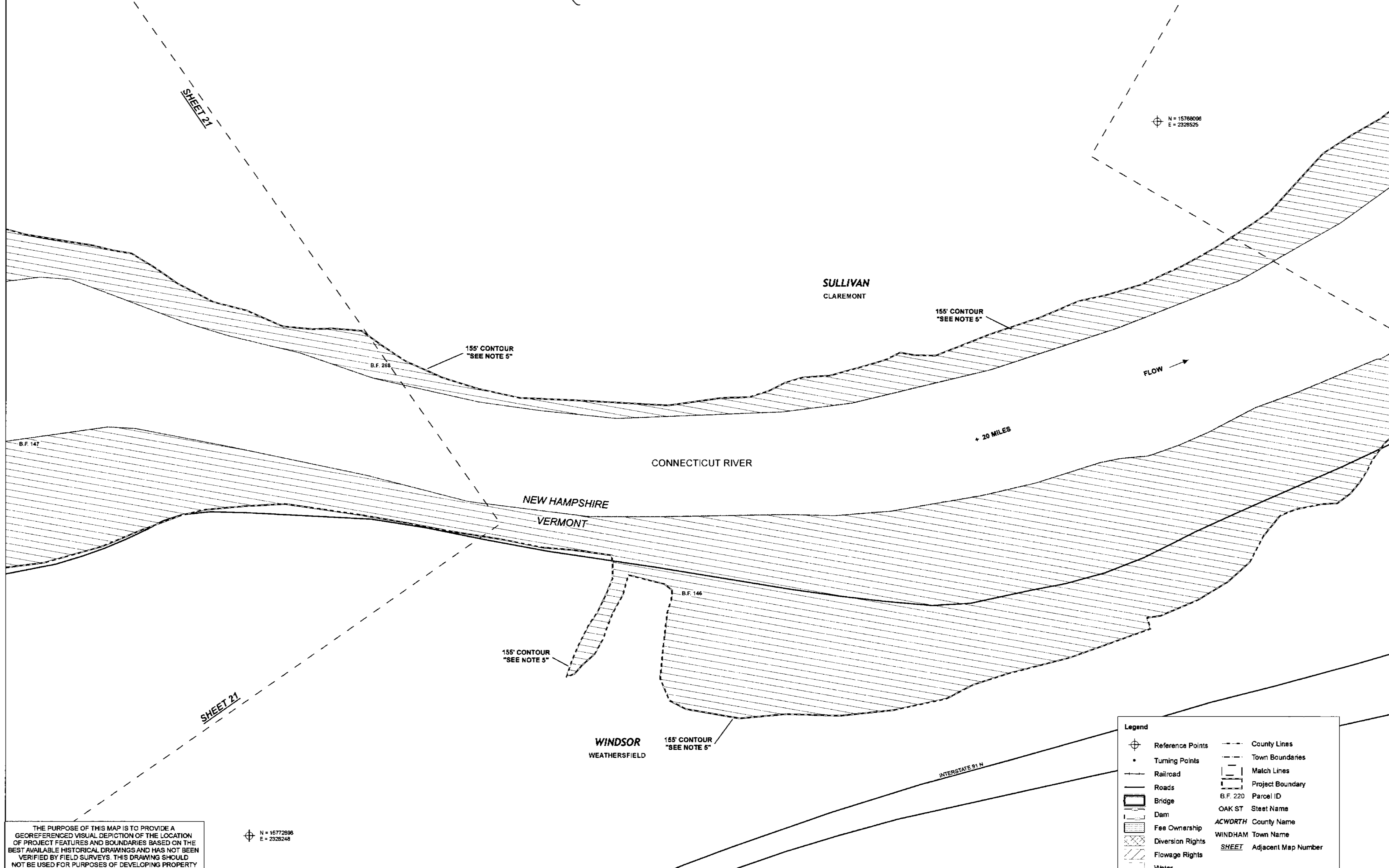

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EXHIBIT K SHEET 20 OF 24

TransCanada Hydro Northeast Inc

Bellows Falls Project-No.1855

Project Boundary Map

1:2,400

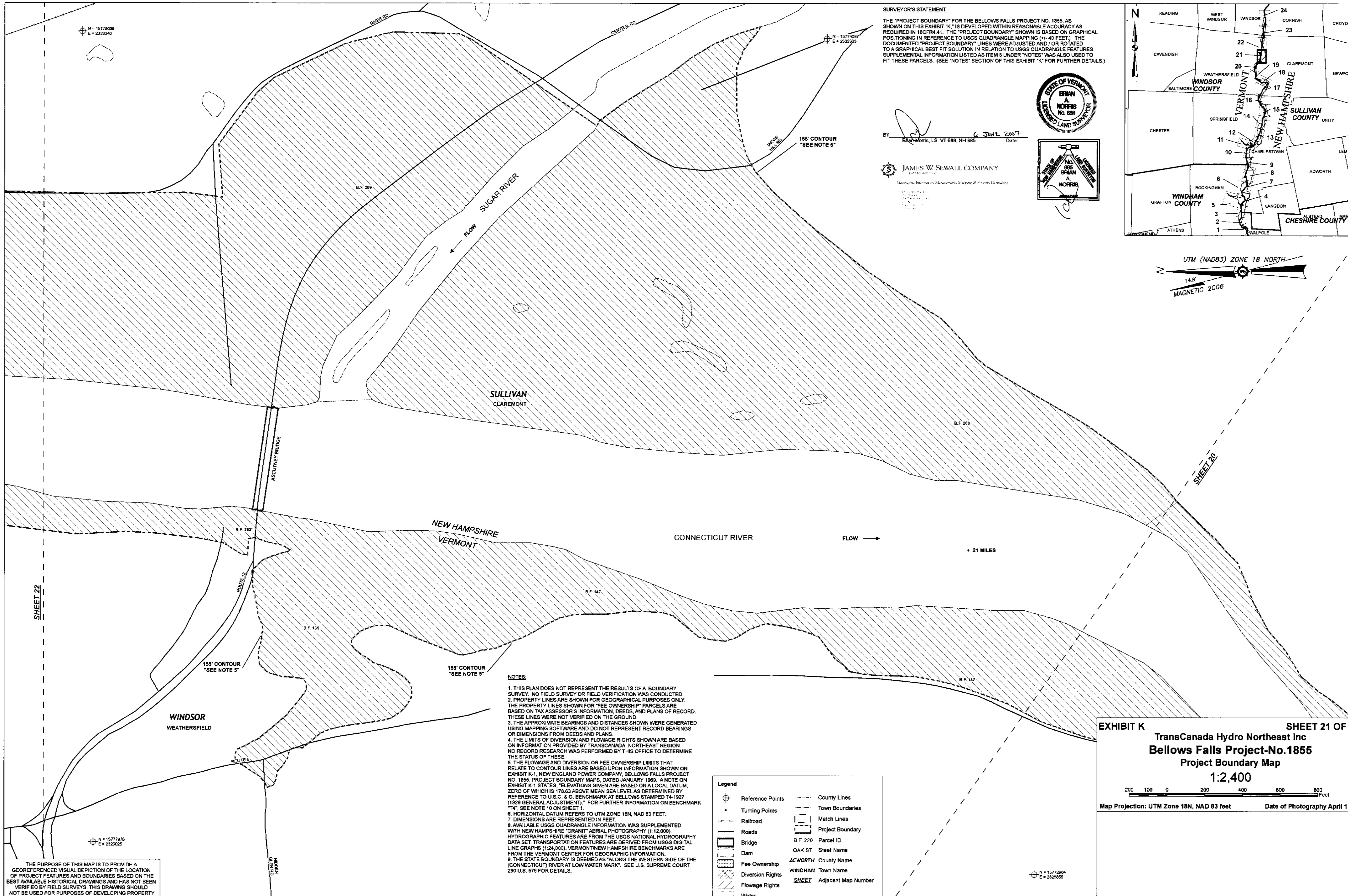
200 100 0 200 400 600 800 Feet

Map Projection: UTM Zone 18N, NAD 83 feet — Date of Photography April 1998

Non-Internet Public Material under 18 CFR §388.112

JAMES W. SEWALL COMPANY PROJECT NUMBER: 52060T

FERC Drawing # P-1855-118 **H-204219**



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JAMES W. SEWALL COMPANY
Geographic Information Management, Mapping & Forestry Consulting

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6. HORIZONTAL DATUM REFERS TO UTM ZONE 18N, NAD 83 FEET.
7. DIMENSIONS ARE REPRESENTED IN FEET.
8. AVAILABLE USGS QUADRANGLE INFORMATION WAS SUPPLEMENTED WITH NEW HAMPSHIRE "GRANIT" AERIAL PHOTOGRAPHY (1:12,000). HYDROGRAPHIC FEATURES ARE FROM THE USGS NATIONAL HYDROGRAPHY DATA SET. TRANSPORTATION FEATURES ARE DERIVED FROM USGS DIGITAL LINE GRAPHS (1:24,000). VERMONT/NEW HAMPSHIRE BENCHMARKS ARE FROM THE VERMONT CENTER FOR GEOGRAPHIC INFORMATION.
9. THE STATE BOUNDARY IS DEEMED AS "ALONG THE WESTERN SIDE OF THE (CONNECTICUT) RIVER AT LOW WATER MARK". SEE U.S. SUPREME COURT 290 U.S. 579 FOR DETAILS.

Legend

Reference Points	County Lines
Turning Points	Town Boundaries
Railroad	Match Lines
Roads	Project Boundary
Bridge	B.F. 220 Parcel ID
Dam	OAK ST Steet Name
Fee Ownership	ACWORTH County Name
Diversion Rights	WINDHAM Town Name
Flowage Rights	SHEET Adjacent Map Number
Water	

THE PURPOSE OF THIS MAP IS TO PROVIDE A GEOREFERENCED VISUAL DEPICTION OF THE LOCATION OF PROJECT FEATURES AND BOUNDARIES BASED ON THE BEST AVAILABLE HISTORICAL DRAWINGS AND HAS NOT BEEN VERIFIED BY FIELD SURVEYS. THIS DRAWING SHOULD NOT BE USED FOR PURPOSES OF DEVELOPING PROPERTY BOUNDARY DESCRIPTIONS.

EXHIBIT K **SHEET 21 OF 24**

TransCanada Hydro Northeast Inc

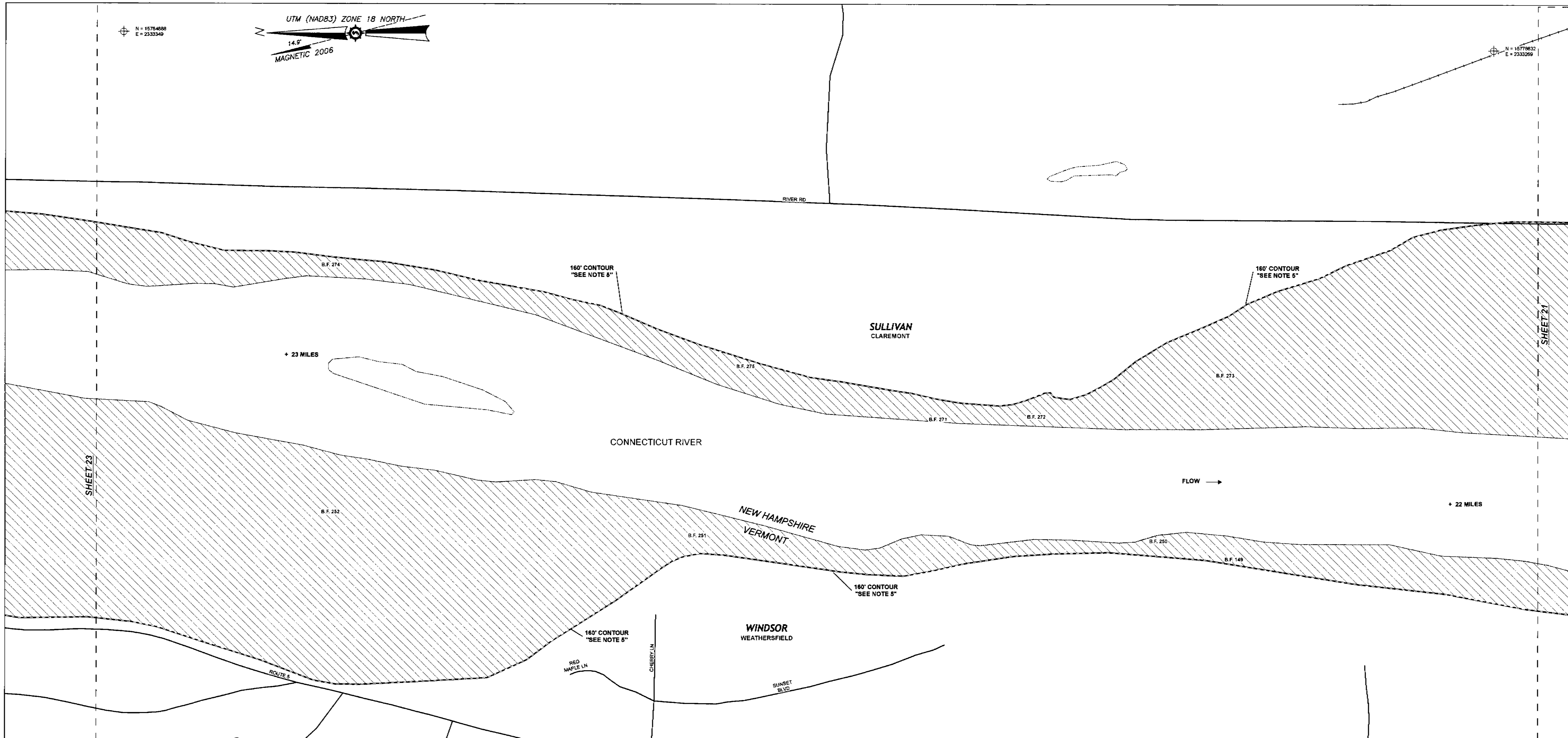
Bellows Falls Project-No.1855

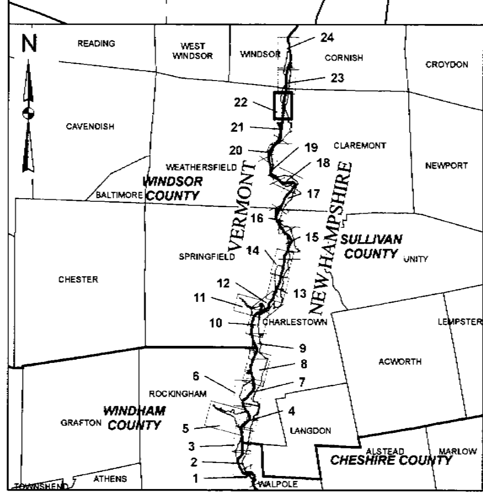
Project Boundary Map

1:2,400

200 100 0 200 400 600 800 Feet

Map Projection: UTM Zone 18N, NAD 83 feet — Date of Photography April 1998





COUNTRY PINE ST

FIRST ST

HILL TOP BLVD

SECOND ST

ROUTE 5

COUNTRY SKYLINE BLVD

STARDUST CIR

THIRD ST

RUNNING BEAR TRL

N = 15763664
E = 2329345

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Legend

⌖	Reference Points		County Lines
•	Turning Points		Town Boundaries
	Railroad		Match Lines
	Roads		Project Boundary
	Bridge	B.F. 220	Parcel ID
	Dam	OAK ST	Steet Name
	Fee Ownership	*ACWORTH*	County Name
	Diversion Rights	WINDHAM	Town Name
	Flowage Rights	*SHEET*	Adjacent Map Number
	Water		

SURVEYOR'S STATEMENT:

THE "PROJECT BOUNDARY" FOR THE BELLOWS FALLS PROJECT NO. 1855, AS SHOWN ON THIS EXHIBIT "K," IS DEVELOPED WITHIN REASONABLE ACCURACY AS REQUIRED IN 18CFR4.41. THE "PROJECT BOUNDARY" SHOWN IS BASED ON GRAPHICAL POSITIONING IN REFERENCE TO USGS QUADRANGLE MAPPING (+/- 40 FEET.) THE DOCUMENTED "PROJECT BOUNDARY" LINES WERE ADJUSTED AND / OR ROTATED TO A GRAPHICAL BEST FIT SOLUTION IN RELATION TO USGS QUADRANGLE FEATURES. SUPPLEMENTAL INFORMATION LISTED AS ITEM 8 UNDER "NOTES" WAS ALSO USED TO FIT THESE PARCELS. (SEE "NOTES" SECTION OF THIS EXHIBIT "K" FOR FURTHER DETAILS.)

BY ____________ 6 JUNE 2007
Brian Norris, LS VT 688, NH 885 Date:

STATE OF VERMONT BRIAN A. NORRIS No. 688 LICENSED LAND SURVEYOR

STATE OF NEW HAMPSHIRE No. 885 BRIAN A. NORRIS LICENSED LAND SURVEYOR

JAMES W. SEWALL COMPANY

NOTES:

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N = 15779899
E = 2328845

EXHIBIT K **SHEET 22 OF 24**

TransCanada Hydro Northeast Inc

Bellows Falls Project-No.1855

Project Boundary Map

1:2,400

200 100 0 200 400 600 800 Feet

Map Projection: UTM Zone 18N, NAD 83 feet — Date of Photography April 1998

Non-Internet Public Material under 18 CFR §388.112

JAMES W. SEWALL COMPANY PROJECT NUMBER: 52060T

FERC Drawing # P-1855-120 **H-204221**

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BY ______ 6 JUNE 2007
Brian Norris, LS VT 688, NH 885 Date:

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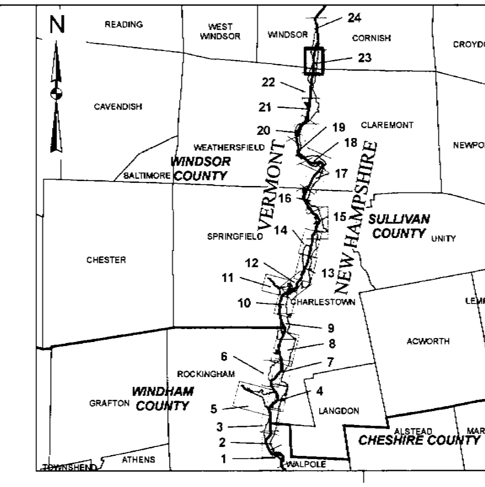
STATE OF NEW HAMPSHIRE No. 885 BRIAN A. NORRIS LICENSED LAND SURVEYOR

JAMES W. SEWALL COMPANY

Geographic Information Management, Mapping & Forestry Consulting



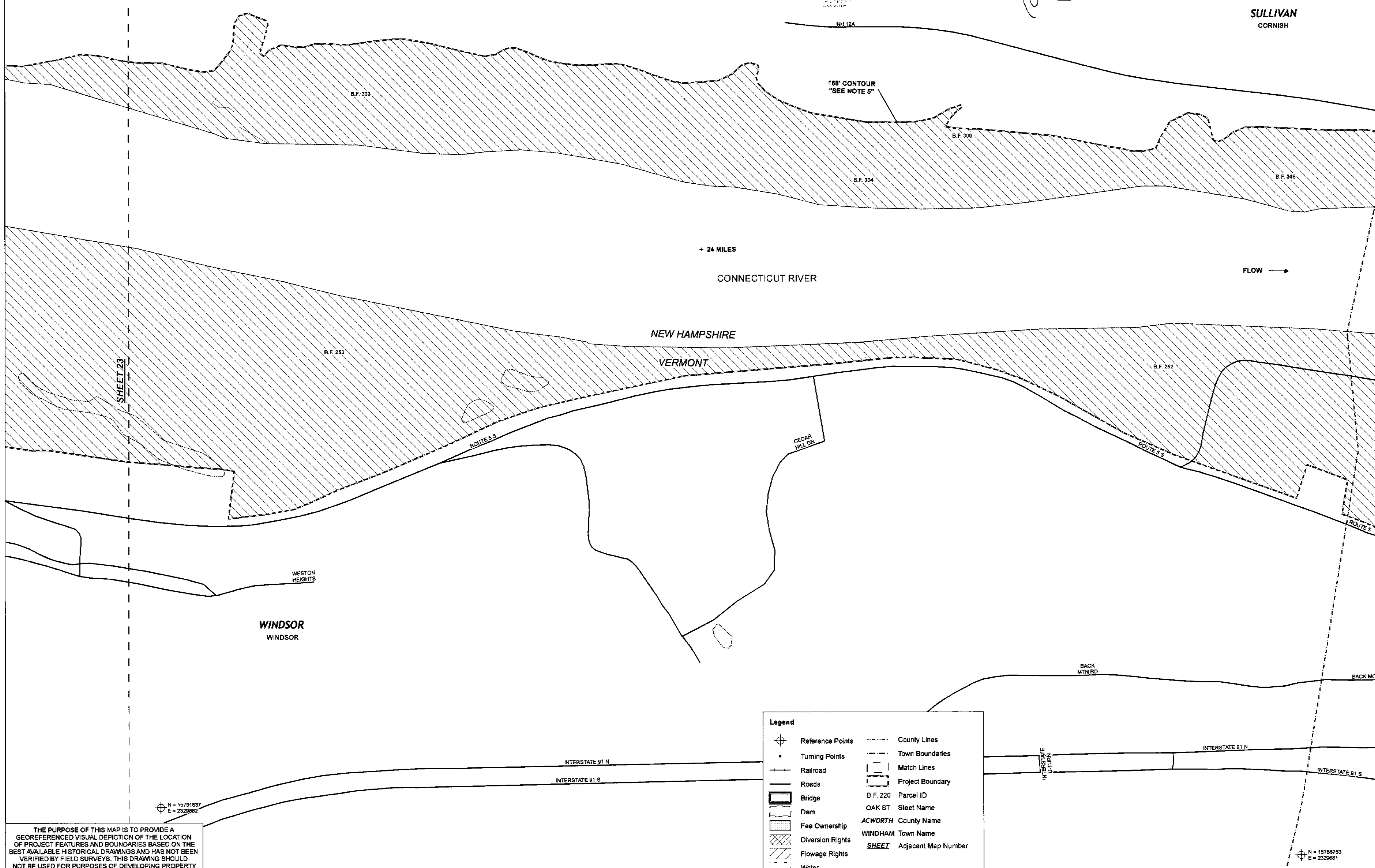


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EXHIBIT K SHEET 23 OF 24

TransCanada Hydro Northeast Inc

Bellows Falls Project-No.1855

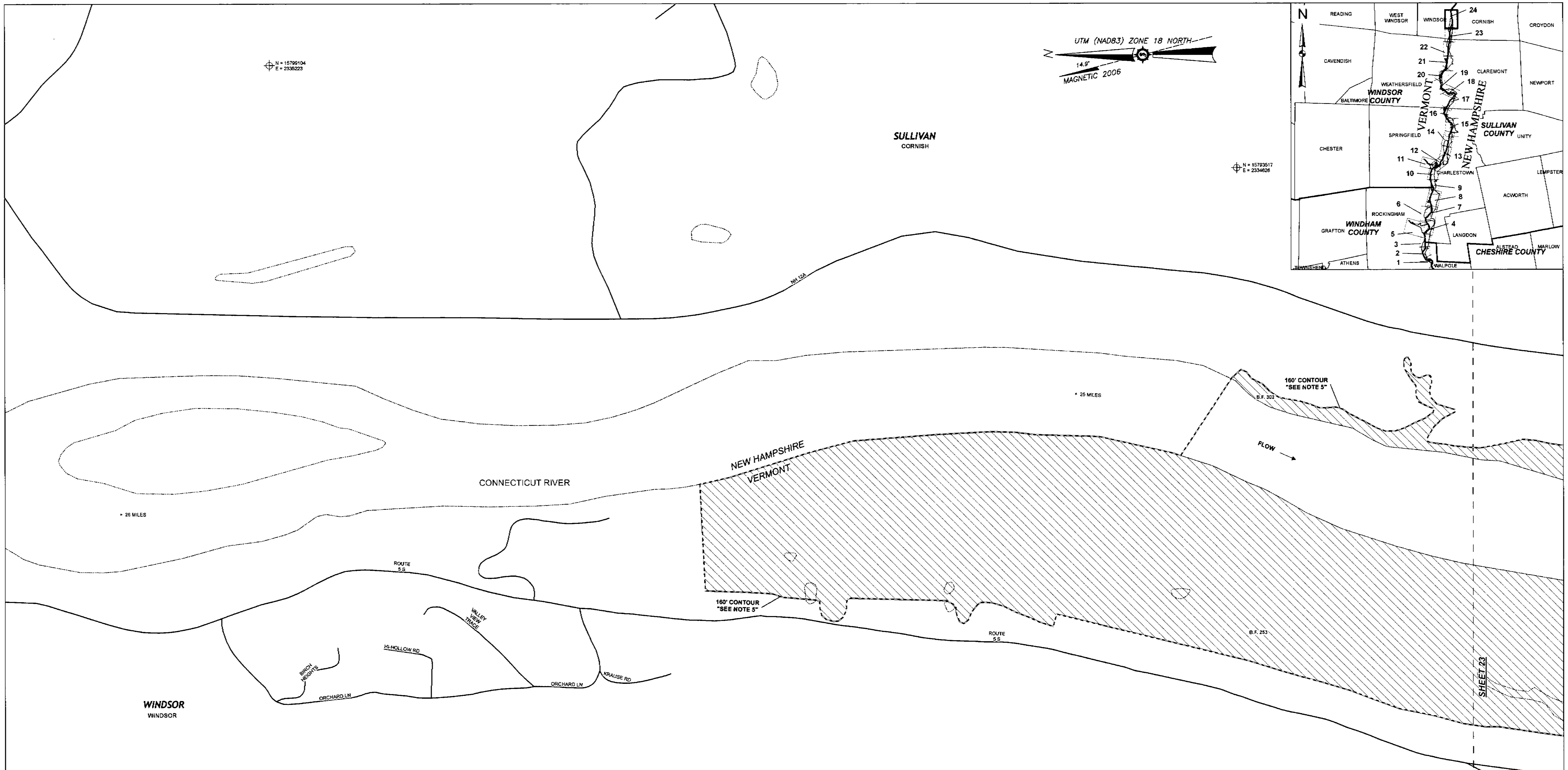
Project Boundary Map

1:2,400

200 100 0 200 400 600 800 Feet

Map Projection: UTM Zone 18N, NAD 83 feet

Date of Photography April 1998



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Legend

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	Turning Points		Town Boundaries
	Railroad		Match Lines
	Roads		Project Boundary
	Bridge	B.F. 220	Parcel ID
	Dam	OAK ST	Steet Name
	Fee Ownership	*ACWORTH*	County Name
	Diversion Rights	WINDHAM	Town Name
	Flowage Rights	SHEET	Adjacent Map Number
	Water		

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JAMES W. SEWALL COMPANY
ESTABLISHED 1880
Geographic Information Management, Mapping & Forestry Consulting

EXHIBIT K **SHEET 24 OF 24**

TransCanada Hydro Northeast Inc

Bellows Falls Project-No.1855

Project Boundary Map

1:3,000

250 125 0 250 500 750 1,000 Feet

Map Projection: UTM Zone 18N, NAD 83 feet **Date of Photography April 1998**

ATTACHMENT 2

PROJECT RECREATION MAPS

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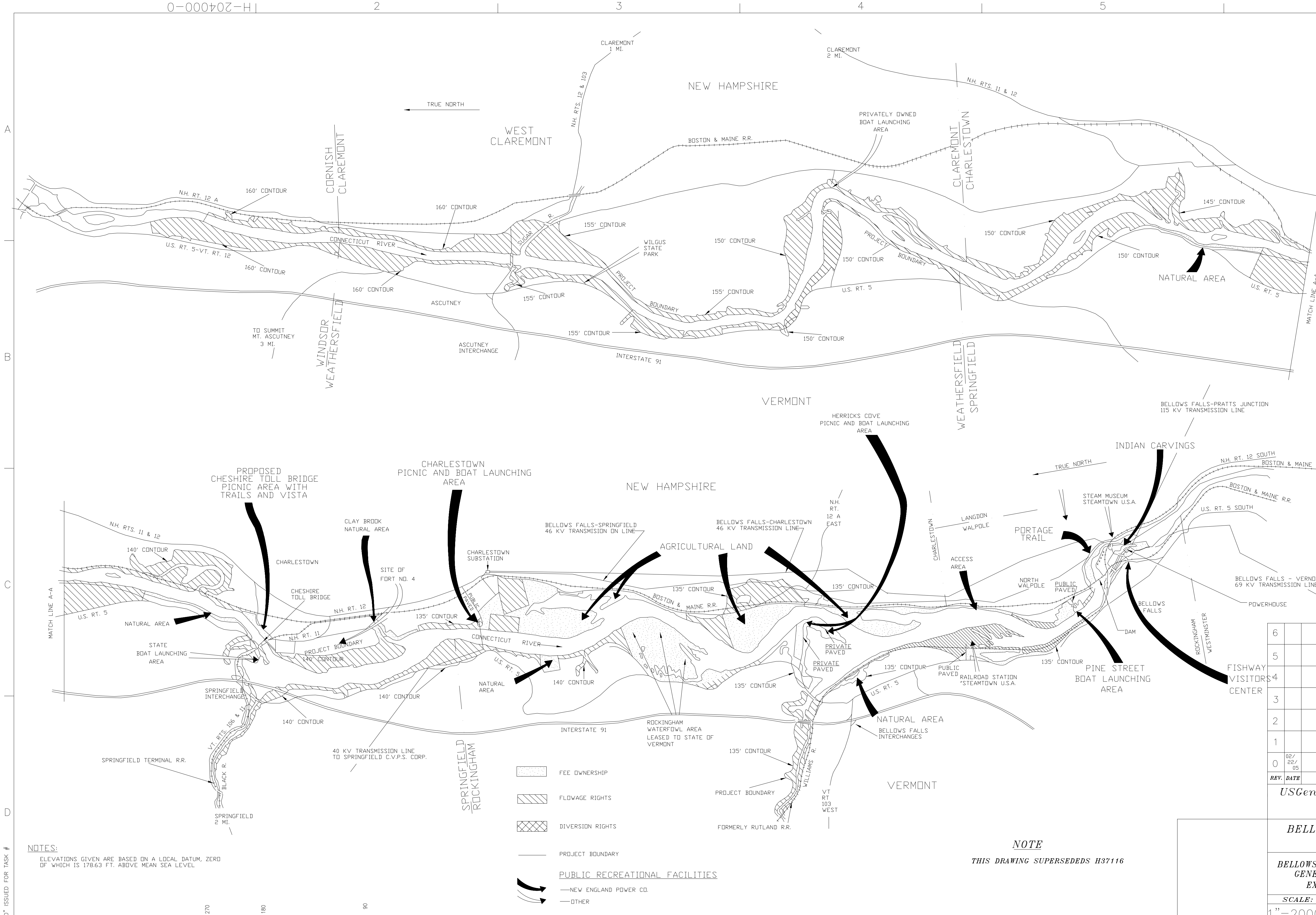

NOTES:
ELEVATIONS GIVEN ARE BASED ON A LOCAL DATUM, ZERO OF WHICH IS 178.63 FT. ABOVE MEAN SEA LEVEL

NOTE
THIS DRAWING SUPERSEDEDS H37116

REV.	DATE	DESCRIPTION	BY	CHK	DES SUP.	APP.	APP.
6							
5							
4							
3							
2							
1							
0	02/22/05	ORIGINAL ISSUE					

USGen New England, Inc
POWER ENGINEERING
LEBANON, NH.

BELLOWS FALLS STATION
ROCKINGHAM, VERMONT

BELLOWS FALLS PROJECT No. 1855-92
GENERAL RECREATION MAP
EXHIBIT R MAP 1 OF 1

SCALE:	DRAWING NO.	REV.
1"=2000'	H-204000	0

INCHES

"0" ISSUED FOR TASK #
NOTED