TRANSCANADA HYDRO NORTHEAST INC.

WILDER HYDROELECTRIC PROJECT

FERC PROJECT NO. 1892

PRE-APPLICATION DOCUMENT

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

Description of Existing Environment and Resources Impacts
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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)
CEII	Critical Energy Infrastructure Information
C.F.R.	Code of Federal Regulations
cfs	cubic feet per second
CPUE	catch per unit effort
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	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
NGO	non-governmental organization
NHPA	National Historic Preservation Act
NOI	Notice of Intent
Normandeau	Normandeau Associates, Inc.

NWI	National Wetlands Inventory
PAD	Pre-Application Document
PM&E measures	Protection, mitigation and enhancement measures
Project	Wilder Hydroelectric Project (FERC No. 1892)
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 (FERC term is Indian) tribes
TWI	Targeted Watershed Initiative
USACE	U.S. Army Corps of Engineers
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
WAP	Wildlife Action Plan

INTRODUCTION

The Licensee, TransCanada Hydro Northeast Inc. (TransCanada) hereby files with the Federal Energy Regulatory Commission (FERC) the required Preliminary Application Document (PAD) for the relicensing of the existing Wilder Hydroelectric Project (Project), FERC No. 1892. 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 Wilder Project is located on the Connecticut River at river mile (RM) 217.4, approximately 1.5 miles upstream of the White River and 7 miles downstream of the Ompompanoosuc River in the town of Hartford, Windsor County, Vermont, and in the city of Lebanon, Grafton County, New Hampshire. The Project extends upstream about 45 miles to a point several miles downstream of both the Wells River and Ammonoousuc River confluences located in the villages of Wells River, Vermont, and Woodsville, New Hampshire.

The Project consists of (1) a concrete gravity dam 1,541 feet long and 59 feet high, having a gated spillway with 6 tainter gates, 2 skimmer gates, and 4 stanchion bays; (2) the Wilder reservoir, extending 45 miles upstream, having a surface area of 3,100 acres at normal full pond elevation of 384.5 feet mean sea level (msl); (3) a powerhouse containing three generating units, two rated at 16,200 kW and one at 3,200 kW; (4) transmission interconnection facilities; (5) fish passage facilities; and (6) 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 U.S. 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 process 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 Wilder Project on October 1, 2012, due to the potential for inclement weather and winter conditions restricting viewing opportunities of the reservoirs 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. 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 web site. 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 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 Wilder Project relicensing have various options for identifying themselves and their interest based upon level of participation and formal status. Identification of these parties can either be through lists maintained by 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 the FERC either prior to or following the issuance of the Notice of Intent to Relicense (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 Section 5.5(c) was derived from a combination of the FERC mailing lists, the FERC service lists, parties identified through previous consultation or outreach, 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 the Wilder 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 Wilder 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 the 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 Wilder 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 public 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 Wilder Project relicensing can be accessed by clicking on the eLibrary link and conducting a general search on the Project docket number (P-1892).

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 relicensing 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 "Wilder Hydroelectric Project FERC No. P-1892 - 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 Wilder 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 (NEPA); 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 NEPA or applicable regulation will be scheduled and noticed by FERC staff. 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. To the extent possible, TransCanada will notify (by email or U.S. Postal Service 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 study plan and study results meetings on the public relicensing website within two weeks following each meeting. Generally, the summary 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 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 agenda, 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 Endangered Species Act (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.

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 1.0.

All requests for public records should clearly indicate the document name, publication date (if known), and FERC Project No. 1892. 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.

In addition, public reference files will be filed with the FERC and available on FERC's eLibrary by searching by the FERC project docket number (P-1892). 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) (18C.F.R.§388.113) is information related to the design and safety of dams and appurtenant facilities, and that 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 (FOIA) request. Instructions for FOIA 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 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 any 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. Postal Service mail or overnight mail.

TransCanada will also provide a 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
Lebanon NH	West Lebanon Library 57 Main Street West Lebanon, NH 03784-1614 (603-298-8544)
Hanover NH	Howe Library 13 South Street Hanover, NH 03755 (603-643-4120)
Lyme NH	Converse Free Library 38 Union Street Lyme, NH 03768-9702 (603-795-4622)
Orford NH	Orford Free Library 311 Route 25A Orford, NH 03777-0186 (603-353-9166)
Piermont NH	Piermont Public Library 130 Route 10 Piermont, NH 03779-0006 (603-272-4967)
Haverhill NH	Haverhill Library Association 67 Court Street Haverhill, NH 03765-0117 603-989-5578
Hartford VT	Hartford Library 1587 Maple Street PO Box 512 Hartford, VT 05047-0512 (802-296-2568)
Norwich VT	Norwich Public Library 368 Main Street Norwich, VT 05055-0290 (802-649-1184)
Thetford VT	Latham Memorial Library 16 Library Lane PO Box 240 Thetford, VT 05074-0240 (802-785-4361)
Fairlee VT	Fairlee Public Library 221 US Route 5 North, PO Box 125 Fairlee, VT 05045-0125 (802-333-4716)
Bradford VT	Bradford Public Library 21 South Main Street, PO Box 619 Bradford, VT 05033-0619 (802-222-4536)
Newbury VT	Tenney Memorial Library 4886 Main Street; PO Box 85 Newbury, VT 05051-0085 (802-866-5366)

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 Indian tribes with jurisdiction over the resource to be studied;
- If the requestor is a not 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 and powerhouse are located on the Connecticut River at river mile (RM) 217.4 approximately 1.5 miles upstream of the White River and 7 miles downstream of the Ompompanoosuc River in the town of Hartford, Windsor County, Vermont, and in the city of Lebanon, Grafton County, New Hampshire. The Project impoundment extends upstream about 45 miles to a point several miles downstream of both the Wells River and Ammonoousuc River confluences located in the villages of Wells River, Vermont, and Woodsville, New Hampshire.

U.S. Route 5 and Interstate 91 run along the Vermont side of the river, while New Hampshire State Route 10 runs along the New Hampshire side. A railroad is located along the Vermont bank. The Project lies within 12 communities: Lebanon, Hanover, Lyme, Orford, Piermont, and Haverhill in New Hampshire; and Hartford, Norwich, Thetford, Fairlee, Bradford, and Newbury 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.

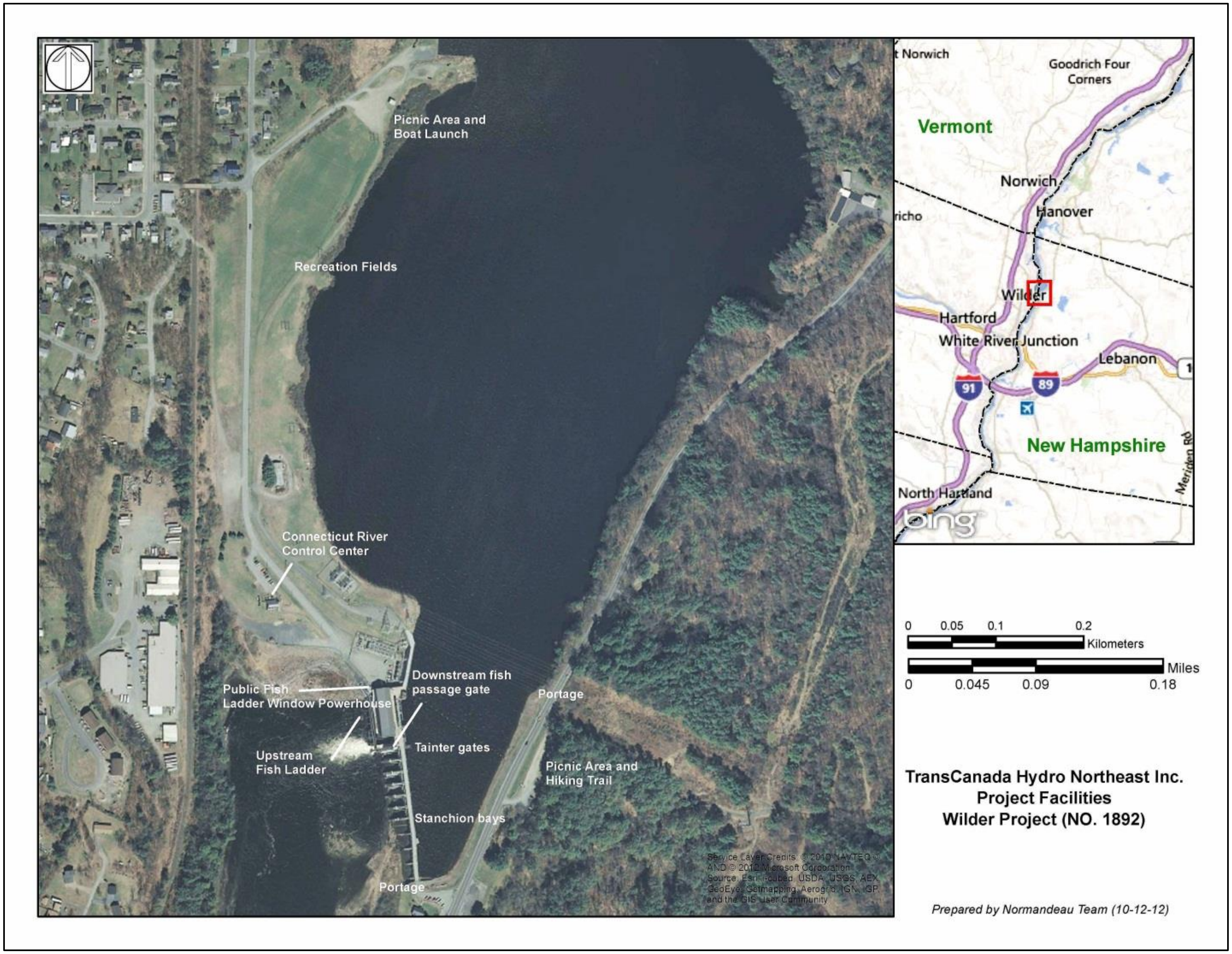

Figure 2.1-1. Primary Project facilities.

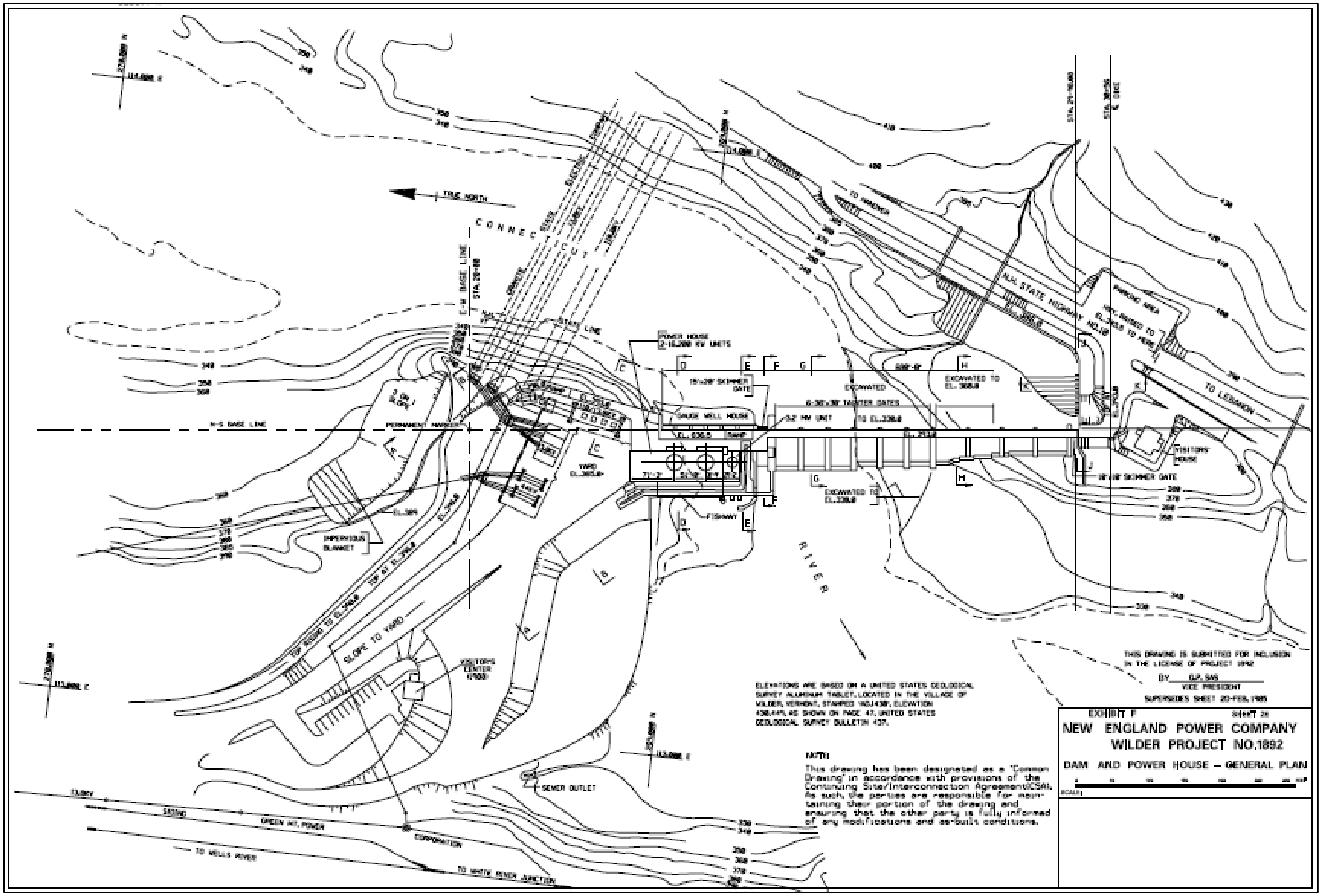

Figure 2.1-2. Project constructed works layout.

Table 2.1-1. Project summary.

General Information	
Owner	TransCanada Hydro Northeast Inc.
FERC Project Number	P-1892
Current License Term	December 10, 1979 – April 30, 2018
Authorized Generating Capacity	35.6 MW
Wilder Project	
Location of Dam	Connecticut River at river mile 217.4
Nearest Towns / Counties	Hartford, Windsor County, Vermont Lebanon, Grafton County, New Hampshire
Drainage Area	3,375 square miles
Major Tributaries	NH - Ammonoosuc River VT - Wells, Waits, and Ompompanoosuc Rivers
Operating Range Elevation	380.0 – 385.0
Normal Range Elevation[a]	382.0 – 384.5
Normal Tailwater Elevation	332.0
Impoundment Length	45 miles (Haverhill, NH / Newbury, VT)
Gross Storage	34,350 acre-feet
Useable Storage	13,350 acre-feet (at 5-foot drawdown)
Surface Area at Normal Full Pond	3,100 acres
Average Annual Inflow at the Project	Approximately 6,400 cfs
Required Minimum Flow	675 cfs or inflow, whichever is less
Generated Minimum Flow[a]	700 cfs

Major Structures and Equipment	
Original Construction	1950
Dam	Rolled earth embankment, reinforced concrete gravity non-overflow section, powerhouse, concrete spillway, earth dike, 1,541 feet long with a maximum height of 59 feet and net head of 51 feet.
Spillway Gates	6 tainter gates, 2 skimmer gates, 4 stanchion bays
Powerhouse	Steel frame and brick masonry construction with reinforced concrete substructure 181 feet long by 50 feet wide.
Turbine/Generator Units	3
Turbine Manufacturer/Type	Units 1-2: S. Morgan Smith / Kaplan adjustable blade Unit 3: Voith / vertical Francis
Turbine Capacities	Units 1–2: 19 MW / 23,750 hp / 6,000cfs @ 49 ft head Unit 3: 3 MW / 4,470 hp / 700 cfs @ 58 ft head
Generator Manufacturer	Units 1-2: Allis Chalmers Unit 3: Siemens
Generator Capacities	Units 1-2: 18,000 KVA / 16,200 KW with 0.9 power factor Unit 3: 3,555 KVA / 3,200 KW with 0.9 power factor
Total Discharge Capacity	157,600 cfs
Fish Ladder	Reinforced concrete, overflow weir fish ladder with 58 pools and 54 feet of vertical rise, collection facility, and viewing windows.
Upgrades	Fish ladder installed in 1987, a third generating unit installed in 1987, and the station was 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 agents for the Licensee pursuant to 18 C.F.R. § 5.6(d)(2)(i):

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

Mr. Michael E. Hachey
Vice President, Regulatory Affairs and Compliance
TransCanada Hydro Northeast Inc.
110 Turnpike Road, Suite 300
Westborough, MA 01581
Telephone: (508) 871-1852
mike_hachey@transcanada.com

Ms. Erin A. O'Dea, Esq.
Legal Counsel
TransCanada Hydro Northeast Inc.
110 Turnpike Road, Suite 300
Westborough, MA 01581
Telephone: (508) 599-1434
erin_odea@transcanada.com

2.2 PROJECT HISTORY AND AMENDMENTS

On April 22, 1944, the original Wilder Project license was issued to the Bellows Falls Hydro-Electric Corporation by the Commission with the intent to construct a new integrated powerhouse and concrete dam 0.5 mile downstream of an existing dam, powerhouse and paper mill complex known as the Olcott Falls mill (see section 3.12, *Cultural Resources*). After the July 28, 1948, license transfer to New England Power Company, reconstruction of the present-day Wilder Project began in March 1949 and commenced operations on December 1, 1950. The original license for the Project expired on June 30, 1970, and the Project operated under annual licenses until the license was renewed on December 10, 1979. A December 11, 1985, amendment authorized the construction of a fish ladder, powerhouse expansion and a third 3.2 megawatt (MW) unit.

On October 5, 1978, the Commission approved a settlement agreement concerning fish passage facilities for American shad and Atlantic salmon at the Wilder Project, and at two downstream projects - Bellows Falls (Project No. 1855) and Vernon (Project No. 1904). The settlement was executed on December 30, 1977, among the Licensee; the states of Massachusetts, Connecticut, New Hampshire, and Vermont; U.S. 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 Wilder's construction and operation occurring after completion of the two fishways downstream. The installation of a new 3.2 MW unit harnessed the required minimum flow for additional generation while utilizing the unit discharge for ladder entrance attraction water supply (see section 2.3.1 for more information). Construction of the fish ladder and third generating unit was completed in 1987.

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. Downstream fish passage at Wilder uses an existing surface gate adjacent to the fish ladder exit and powerhouse without structural modification or license amendments. Downstream passage at the Wilder Project began in 1988.

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 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 24, 2005, FERC approved the transfer of the license to TransCanada Hydro Northeast Inc., the current Licensee.

2.3 PROJECT FACILITIES

2.3.1 Dam, Embankment, Spillway

The dam is a concrete gravity structure extending across the Connecticut River from Hartford, Vermont, to Lebanon, New Hampshire. The dam structures include an earthen embankment about 400 feet long, a non-overflow gravity concrete bulkhead wall 232 feet long, a concrete forebay intake 208 feet long, a gravity concrete spillway about 526 feet long and 59 feet in maximum height and another earthen embankment about 180 feet long. The south embankment is 13 feet in maximum height and the north embankment is primarily a natural bank to which protection has been added. Figures 2.3-1 and 2.3-2 and table 2.3-1 provide additional detail.

Figure 2.3-1. Powerhouse, dam, and fish ladder.

The spillway portion of the dam is divided into four sections: skimmer gate, tainter gates; stanchion flashboards, and another skimmer gate. The various bays are separated by concrete piers supporting a steel and concrete bridge. The non-overflow section crest is at El. 393. See figure 2.3-2 and table 2.3-1.

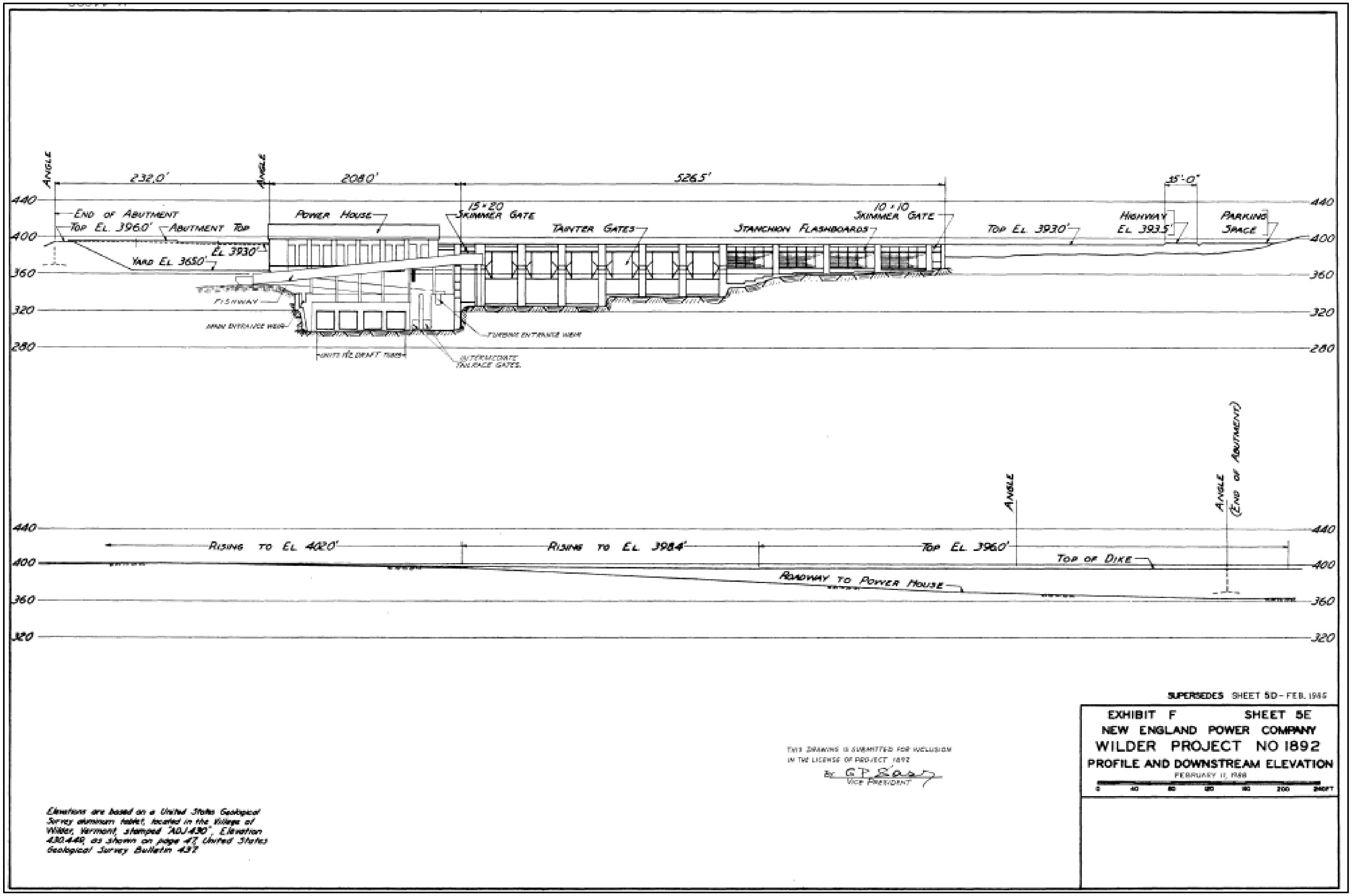

Figure 2.3-2. Spillway profile.

Table 2.3-1. Spillway facilities.

Gate Type	Number	Size (height or width, by length in feet)	Elevation
Tainter gates	6	30 x 36	355.0 (sill)
Stanchion bays	4	17 x 50	368.0 (crest)
Skimmer gate	1	15 x 20	365.0 (sill)
Skimmer gate	1	10 x 10	375.0 (sill)

2.3.2 Powerhouse Features

The powerhouse superstructure is 181 feet by 50 feet by about 50 feet high and is constructed of steel frame and brick construction. The boundary line between New Hampshire and Vermont lies between Unit 1 and Unit 2. The powerhouse contains three turbine generator units, 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 concrete gravity intake is integral with the powerhouse structure with two water passages for each of the larger generating units and a single water passage for the 3,200 kW unit (Unit No. 3). Water enters directly from the forebay intake and into the scroll or wheel cases. The draft tubes discharge into a short tailrace excavated partly in the bank and partly in the bed of the river. The scroll cases and draft tubes are formed in the concrete of the substructure, which was poured on rock.

The water passages for the two larger generating units have trash racks (5.5-inch on center) and head gates consisting of one flat steel sliding panel and one wheel-type gate for each unit. Each head gate is equipped with an electrically driven fixed hoist. Unit No. 3 has a trash rack (1.5-inch on center) and an 8-foot-diameter butterfly valve. A hydraulic “rack rake” is used to pull river debris away from the unit intakes. It is manually operated and is driven to the trash racks in front of each unit on a set of tracks that are located on top of the dam. The rake head is lowered to the bottom of the racks and is then retracted upward along the rack to remove debris. The debris is then conveyed into a trailer for removal.

The powerhouse substructure is of reinforced concrete construction. The original generating unit draft tube gates are operated by electric hoists mounted on an external catwalk on the downstream face of the powerhouse. The Unit No. 3 draft tube slide gate is operated by motor driven screw stem hoists in the powerhouse.

Unit No. 3 was installed in the spare third unit bay on the left end of the powerhouse and was placed in commercial service on October 16, 1987. Figures 2.3-3, 2.3-4, and 2.3-5 and table 2.3-2 provide additional details.

Figure 2.3-3. Generator Units No. 1 and 2.

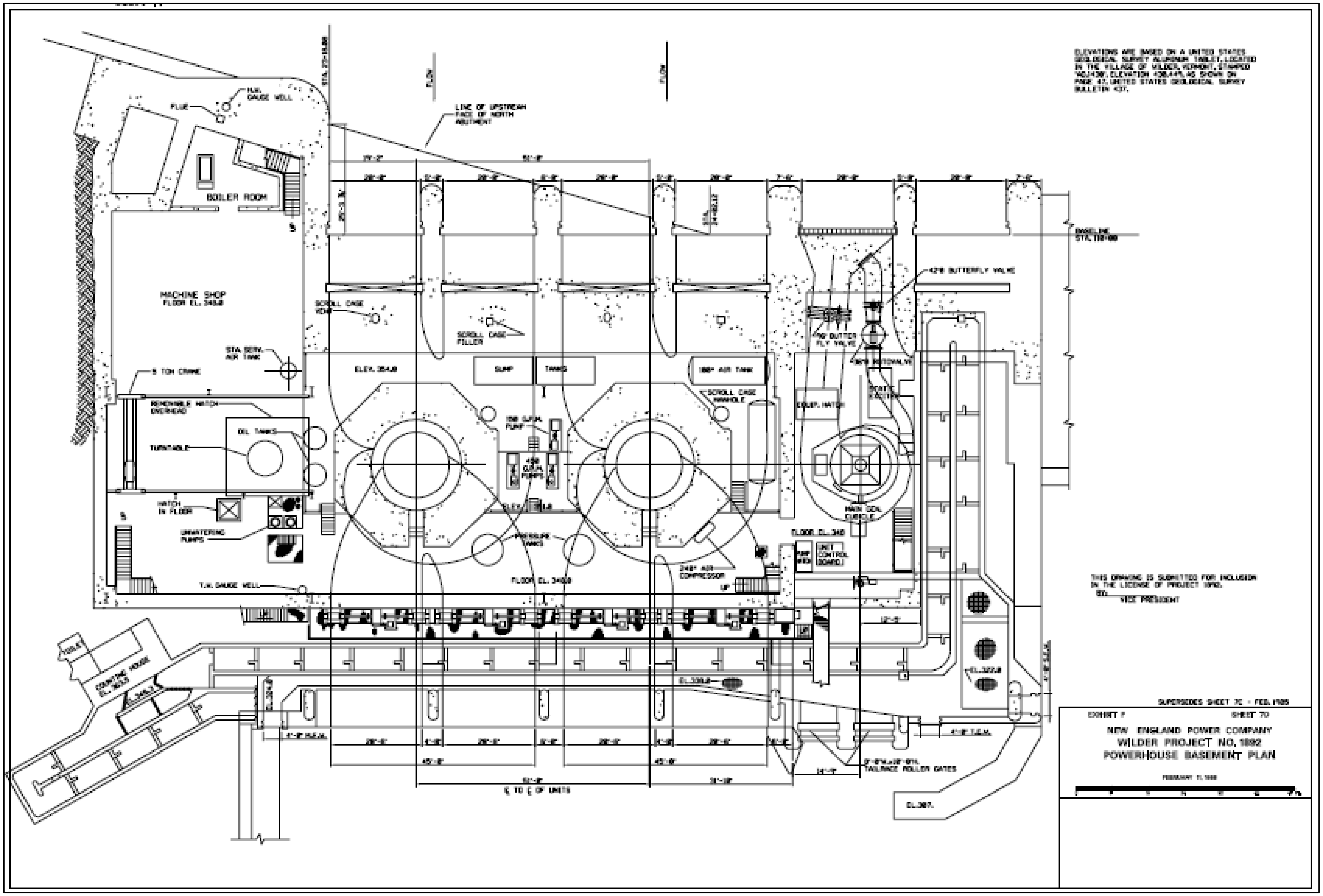

Figure 2.3-4. Powerhouse layout.

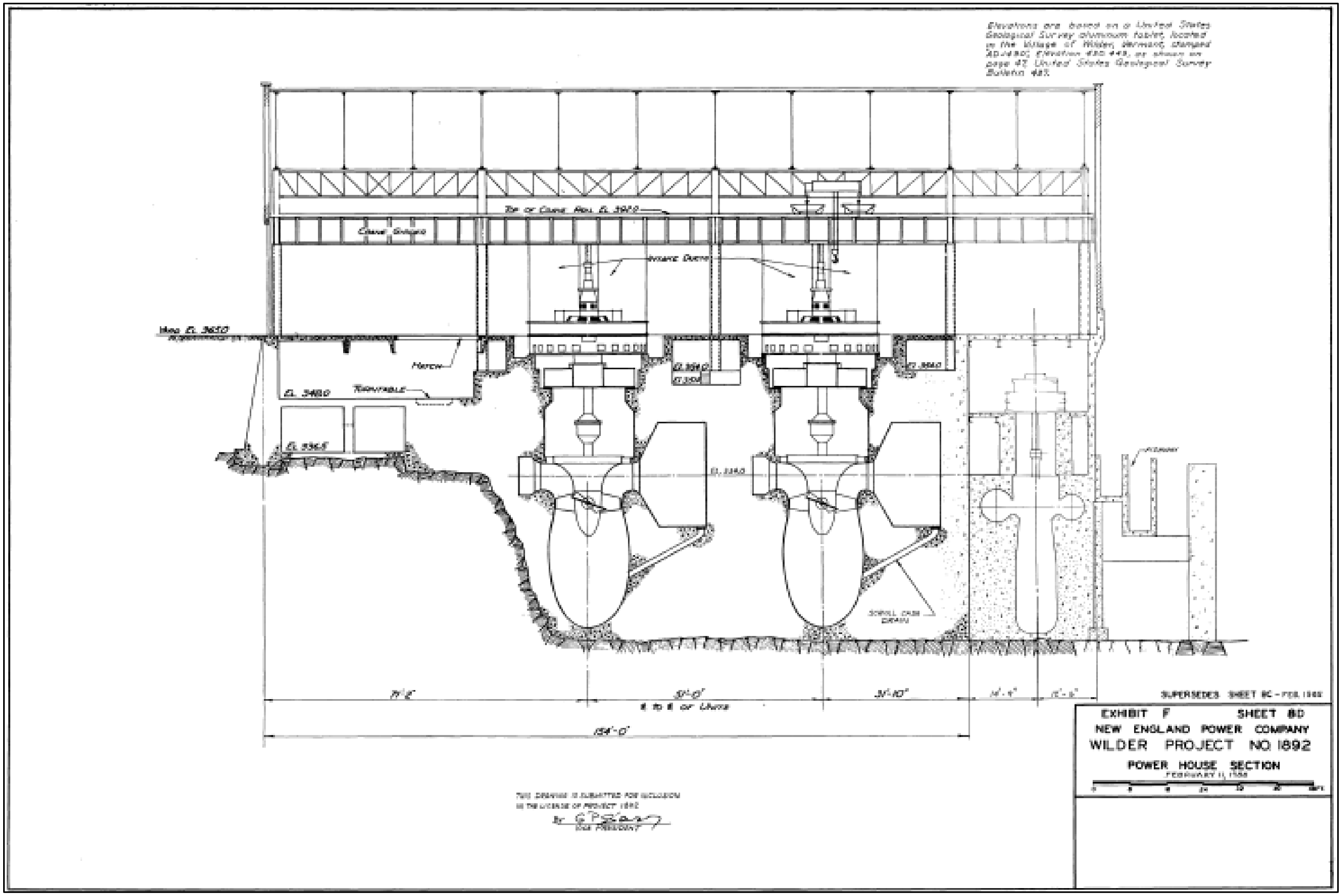

Figure 2.3-5. Powerhouse cross section (Units No. 1 and 2).

Table 2.3-2. Turbines and generators.

Unit Nos.	1, 2	3
Turbines		
Type	Kaplan adjustable blade propeller type	Francis vertical runner
Design Head (feet)	49	58
HP Rating at Design Head	23,750	4,470
RPM	112.5	212
Min. Hydraulic Capacity (cfs)	~ 1,000	700
Max. Hydraulic Capacity at Design Head (cfs)	6,000	700
Intake Trashrack Clear Spacing	5.5 inch on center	1.5 inch on center
Generators		
Nameplate KVA	18,000	3,555
Nameplate KW	16,200	3,200
Power Factor	90	90
Phase/Frequency	3/60	3/60
Voltage	13,800	13,800

Unit Nos. 1 and 2 each have direct connected main and pilot exciters as well as spare motor-generator excitation for the plant. In 1987, Unit No. 3 was installed to efficiently pass minimum flow at the Project and to provide discharge water that functions as attraction water for the fish ladder entrance, which was installed that same year. The powerhouse contains a switchboard and control room that are only used as a backup facility to the Connecticut River Control Center, which is located at a separate facility at the Wilder Project.

Project electrical facilities include the generators, generator terminals which extend from the powerhouse to the 13.8 KV bus of the outdoor substation, and station service transformers located inside the substation. The high-voltage transmission lines, switchyards and substation transformers and equipment located inside a fenced area adjacent to the powerhouse lie within the Project boundary but are not Project facilities. Instead, this equipment is owned and operated by one of the regional transmission companies, New England Power Company (NEP), d/b/a National Grid. The controls for the 13.8 KV, 46 KV and 115 KV lines and for the outdoor substation, also owned by NEP, are located inside the powerhouse. Figure 2.3-6 illustrates the separation of electrical facilities between the Project and the regional transmission system.

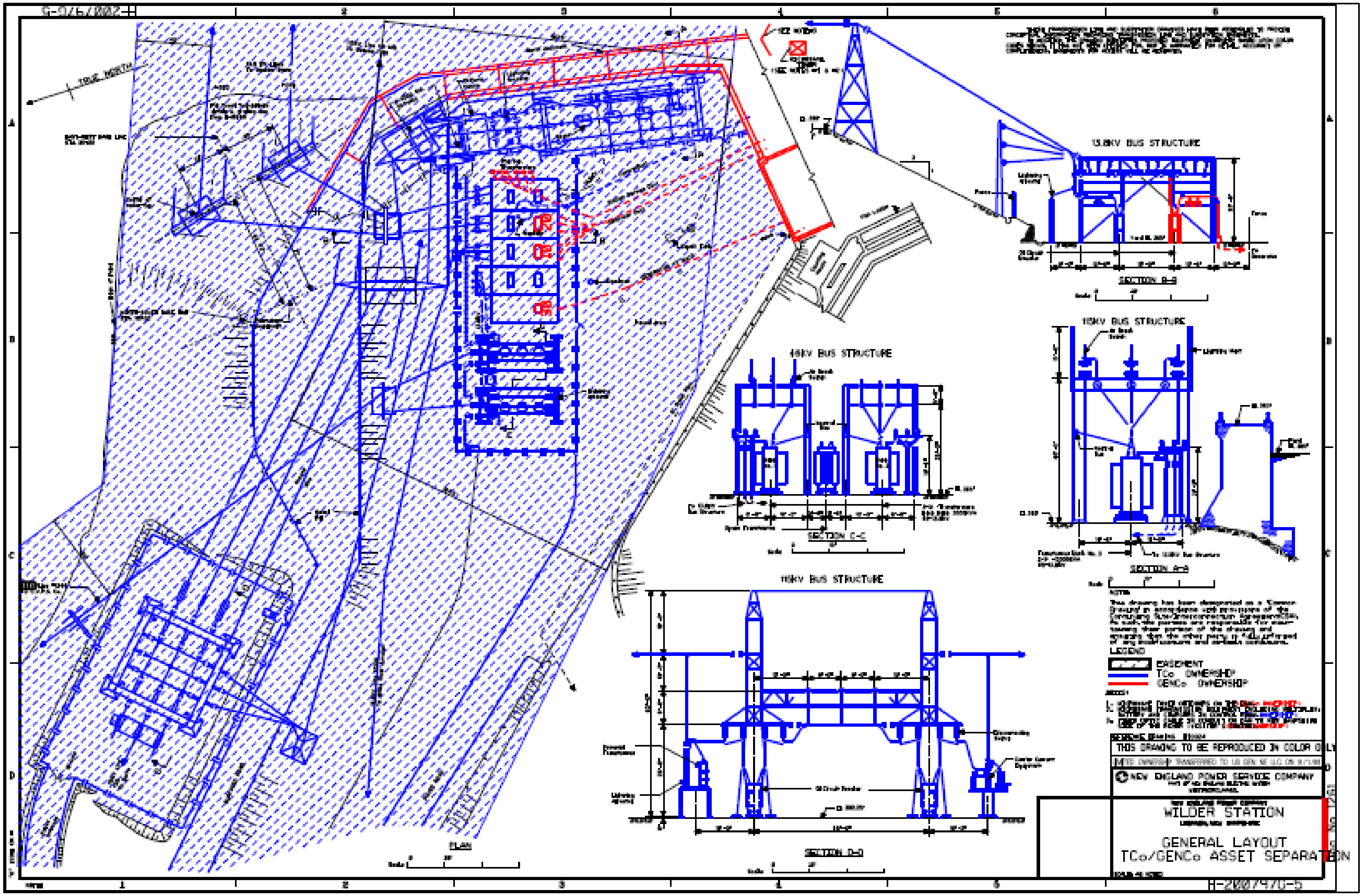

Figure 2.3-6. Project transmission interconnection with non-project transmission grid (red is project facilities).

2.3.3 Fish Passage Facilities

Upstream Fish Passage - Ladder Operation

The Wilder fishway is a reinforced concrete structure with accessory electrical, mechanical, and pneumatic equipment which was designed to provide passage past the dam for migrating Atlantic salmon and American shad. Upstream migrating fish are guided to the ladder entrance by attraction water supplied from the discharge of the Unit No. 3's generator and collection channel weirs. When Unit No. 3 is not available there is a Unit No. 3 bypass to supply the attraction water. Upstream migrating fish enter the tailrace area where fish are attracted to the main entrance weir (MEW) at the northwest end of the powerhouse.

A spillway entrance weir (SEW) and a turbine entrance weir (TEW) are incorporated into the southeast and southwest walls of the attraction water channel for use under varying tailwater conditions. The SEW is a gated entrance slot used for fish attraction from the spillway area, where fish may congregate during high-water "spill" conditions. The TEW is a gated entrance slot which is used for fish attraction during minimum flow operation of the "continuous-flow" turbine (Unit No. 3). The attraction water weirs, when used, open fully and are not modulated (see figures 2.3-7 and 2.3-8).

Fish travel through the six-foot wide entrance channel along the powerhouse to the attraction water floor diffuser in the southeast half of a spare turbine bay between the powerhouse and the concrete dam. From the attraction water diffuser, fish enter a six-foot wide fishway entrance channel and "climb" to the forebay by swimming through a series of 58 pools created by a sequence of overflow weirs with each succeeding weir spaced ten feet apart and 12 inches higher than the last.

After passing 28 pools, the fish enter the counting/trapping area, 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. At this location they can be trapped and diverted to a holding pool by means of manually activated pneumatic trapping gates. From the counting/trapping area, fish continue to swim through an additional 30 overflow weirs and pools to the 5-foot wide fishway exit channel in the spillway adjacent to the powerhouse. The exit channel (the last pool) includes a motor driven headgate, trashracks with 12 inch spacing, and slots for wooden stop logs. The headgate is either open or closed.

The last five weirs in the vertical slot section contain adjustable weir gates which can be lowered (opened) to provide a nearly constant 20 cubic feet per second (cfs) fishway flow when the forebay elevation drops through its normal operating range. As the pond elevation rises and falls, these gates are programmed to maintain a nearly constant water level of 12 inches over the first fixed weir downstream of the five adjustable weirs by means of a water level monitor and control system.

An outdoor public viewing area with an observation deck and underwater window is located at the fishway's northwest end on the Vermont shore adjacent to the powerhouse parking lot.

Figure 2.3-7. Fish ladder.

Upstream Fish Passage - Entrance Attraction Water - Unit No. 3 Discharge

The entrance weir's attraction water flows (see figure 2.3-9) are dependent upon the tailwater elevation. Attraction water flow ranges proportionally from 60 cfs at low tailwater (station generated minimum flow of 700 cfs); to 200 cfs at normal tailwater (full-load generation of 10,700 cfs); to 320 cfs at "Design High Tailwater" (combined generation and spill of 15,000 cfs). Attraction water to the entrance weir consists of about 25 cfs from fishway flow with the balance introduced through a floor diffuser just upstream of the entrance channel.

Attraction water supplied to the floor diffuser is conveyed from the forebay through Unit No. 3, which passes 700 cfs. The attraction water system is designed to utilize the energy available in the head pond supply source by passing the flow through the unit. During fishway operation the water level in the intermediate tailrace is regulated by twin tailrace gates, modulated to restrict discharge of the intermediate tailrace and maintain an elevation approximately 1-1/2 feet above the tailrace. This head differential in the intermediate tailrace forces attraction water through a tunnel under the wall bisecting the spare bay, through stilling and turning vanes, where it flows up and through the fishway's floor diffuser.

The attraction water control system is programmed to modulate the tailrace gates to maintain the entrance channel water level 1/2 foot above the tailrace level. Also included are tailrace and diffuser water level monitors and a 2.5 minute time delay to prevent reactivation of tailrace gate operation. A high water alarm sends a visible and audible signal to the station operator, if the fishway-tailrace differential exceeds two feet.

The operating season of the fish ladder has been determined by the schedule provided each year by CRASC. The ladder operates annually during the spring and fall seasons. In the spring, migration typically has not started before May 15th and more specifically, began when Atlantic salmon arrived and passed the ladder at the downstream Bellows Falls Project. In the fall migration season, although generally specified as between September 15th and November 15th, the ladder is typically not operated until there is evidence that a salmon is located immediately below the Wilder Project. To date, all Atlantic salmon released into the Connecticut River at the Holyoke Project (FERC No. 2004) fish lift in Massachusetts have had a radio tag implanted in them by TransCanada with concurrence from state and federal agencies in order to track their migration in the river basin.

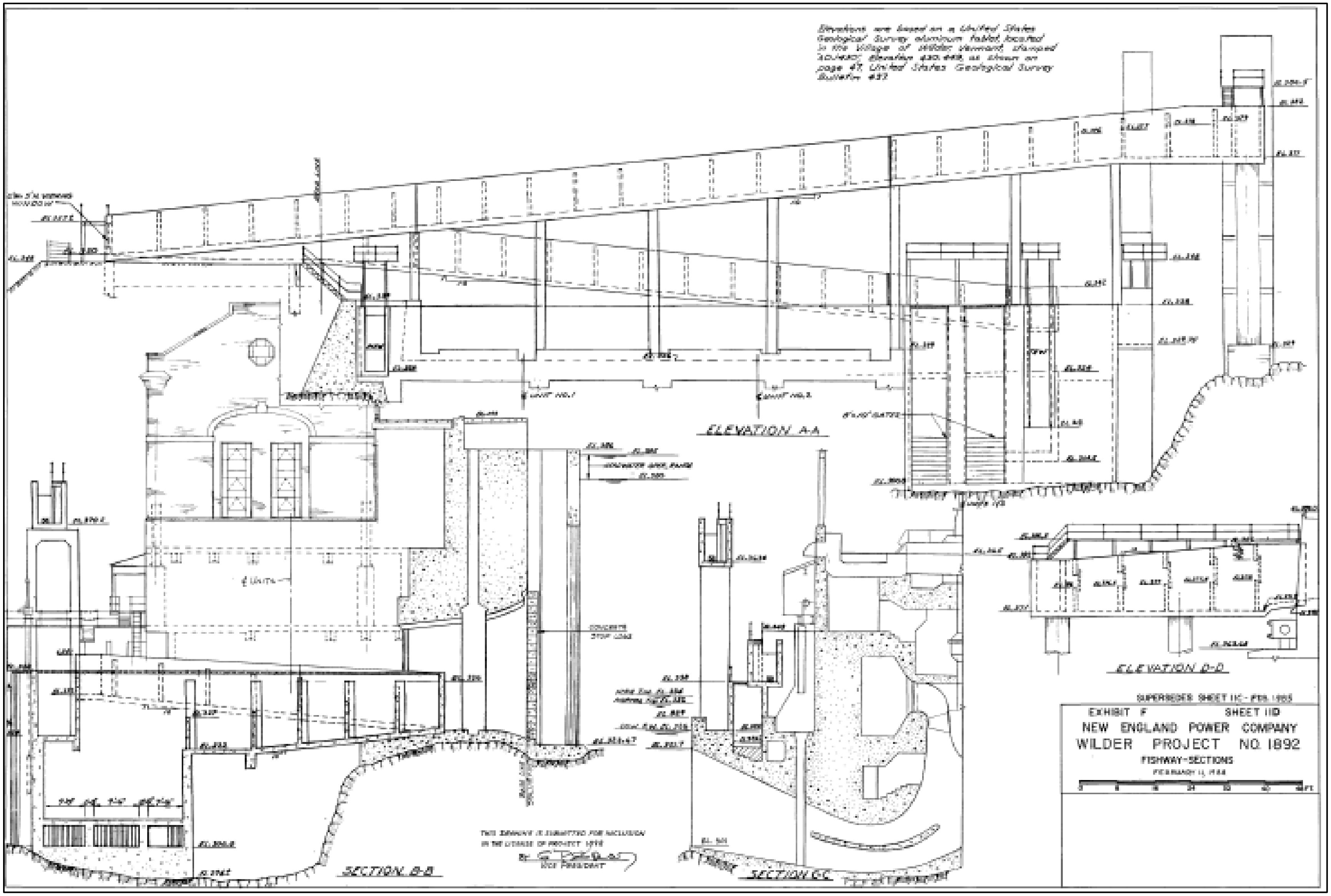

Figure 2.3-8. Fish ladder layout.

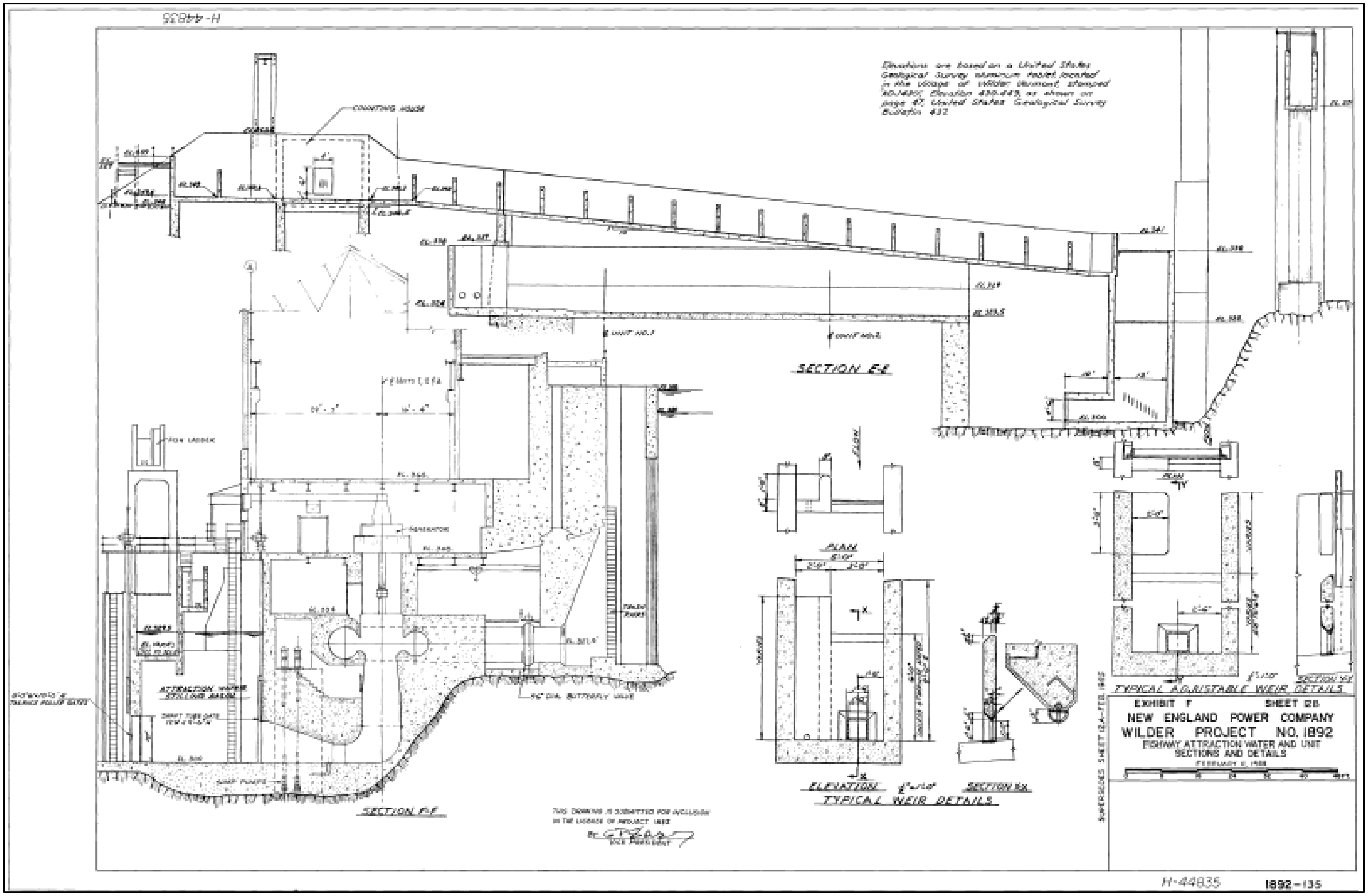

Figure 2.3-9. Attraction water cross-section.

Upstream Fish Passage – Effectiveness Evaluations

No formal effectiveness studies have been performed on the fish ladder due in large part to the lack of returning adult Atlantic salmon to the Connecticut River Basin overall, but in particular the small number of adults passing Bellows Falls dam and arriving at the base of Wilder dam. However, the Vermont Department of Fish & Wildlife (Vermont Fish & Wildlife) and Normandeau Associates, Inc. (Normandeau) have monitored adult Atlantic salmon utilization of the Wilder fish ladder since 1998. The first radio tagged adult salmon to pass was in 1999. Few fish have been radio-tagged at Holyoke (typically 10 fish/year). Overall, 44 percent of all salmon that passed the Bellows Falls Project also passed the Wilder Project (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 Bellows Falls dam may migrate up key tributaries, such as the White River before reaching Wilder.

Downstream Fish Passage - Skimmer Gate Operation

Downstream fish passage is provided by the existing log sluiceway located between Unit No. 3 and the fish ladder entrance gallery bay and spillway. The existing sluice gate is motorized and operated locally as needed. A flow of 512 cfs is maintained continuously through the skimmer gate for downstream passage.

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, the skimmer gate is opened primarily to facilitate downstream movement of juvenile Atlantic salmon smolts. It has been typically opened from April 1 through June 15 each year. The fall season is also specified by the CRASC as from October 15 to December 31 for adult movement to final spawning habitat. In practice, due to the fact that adult salmon locations are monitored, the CRASC has not required the spilling of 512 cfs for downstream passage unless an adult is present immediately above the dam. Antennas and receivers are deployed each year above and below the dam to monitor the presence of tagged adult salmon and to confirm their passage.

Downstream Fish Passage – Effectiveness Evaluations

Behavior and movement studies of Atlantic salmon smolts at the Wilder Project were conducted in 1991 and1992. These studies evaluated the existing log/ice sluice to provide safe and effective passage. Additional radio-telemetry studies were conducted in 1993 and 1994 to determine if stream reared smolts behaved differently than hatchery reared smolts, and to see if the log/ice sluice gate setting could be used to enhance passage effectiveness. The majority of radio tagged smolts more readily used a larger gate opening over smaller gate settings, resulting in a recommendation to operate the gate at the larger open setting to facilitate passage. In 1994, a turbine passage survival study was also conducted to determine if the Kaplan turbines were detrimental to smolts passing through them. Smolt survival and passage was found to be very high (see section 3.6, *Fish and Aquatic Resources*, for more information).

2.3.4 Ancillary Buildings and Recreation Facilities

Garage/Service Building

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

Connecticut River Office

This structure located at the New Hampshire end of the dam was formerly a visitors center during construction of the Project. It later served as the Project visitor center until it was replaced by a more modern multi-purpose energy conservation facility in 1987. Today it serves as administrative space for engineering and other support functions.

Wilder Hydro Office

This structure was originally an energy conservation center/project visitor center when the Project was previously owned by an electric utility. Today it houses many functions including the Connecticut River Control Center and offices, and continues to serve as a location for the public to contact and gain information about the Wilder Project.

Recreational Facilities

- Wilder dam picnic area and vista
- Wilder dam portage
- Fish ladder and angler parking

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

2.3.5 Project Boundary and Land

The Wilder Project extends about 45 miles upstream on the Connecticut River in both New Hampshire and Vermont. The Project boundary includes the powerhouse and dam, the impounded portion of the river, a limited amount of TransCanada 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 the Licensee with the ability to flow on, and otherwise affect, lands and properties of others for construction, maintenance and operation of the Project to an elevation not to exceed 385 feet above sea level at Wilder dam. Some of the flowage rights on private properties are tied to an elevation of 390 feet above sea level at Wilder dam. This is because the flowage rights were secured prior to the final design when a higher maximum operating limit was under consideration. Flowage rights are tied to property and may be 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 123 acres of land in the Wilder Project. Of this, 43 acres are used for plant facility area, 59 acres are used for public outdoor recreational use, 10 acres are currently under agreement to Dartmouth College for recreational use and 11 acres remain as undeveloped scattered parcels. More than 30 acres of the recreational land is also undeveloped except for hiking and nature trails. Minor portions of the Project area are subject to the rights of the general public to use public streets and walkways within the area. Detailed Project maps are provided in Attachment 1 to this PAD.

2.3.6 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. TransCanada is also currently investigating construction of a new control center, but such a change would not impact Project operations.

2.4 PROJECT RESERVOIR

The Project includes a 45-mile long impoundment that extends to Newbury, Vermont, and Haverhill, New Hampshire, about 4.0 miles below the Wells River-Woodsville Bridge. The Project has limited storage capacity because of the relatively flat terrain from McIndoes dam downstream to the Project but this is offset somewhat by its length.

The reservoir has a surface area of 3,100 acres and about 105 miles of shoreline. The reservoir has a total volume of 34,600 acre-feet at El. 385 at the top of the stanchion boards. The usable storage amounts to about 13,350 acre-feet in five feet of drawdown to El. 380; however, the typical reservoir operating range is 2.5 feet, between El. 384.5 and El. 382.0. Figures 2.4-1 and 2.4-2 illustrate reservoir conditions at various elevations.

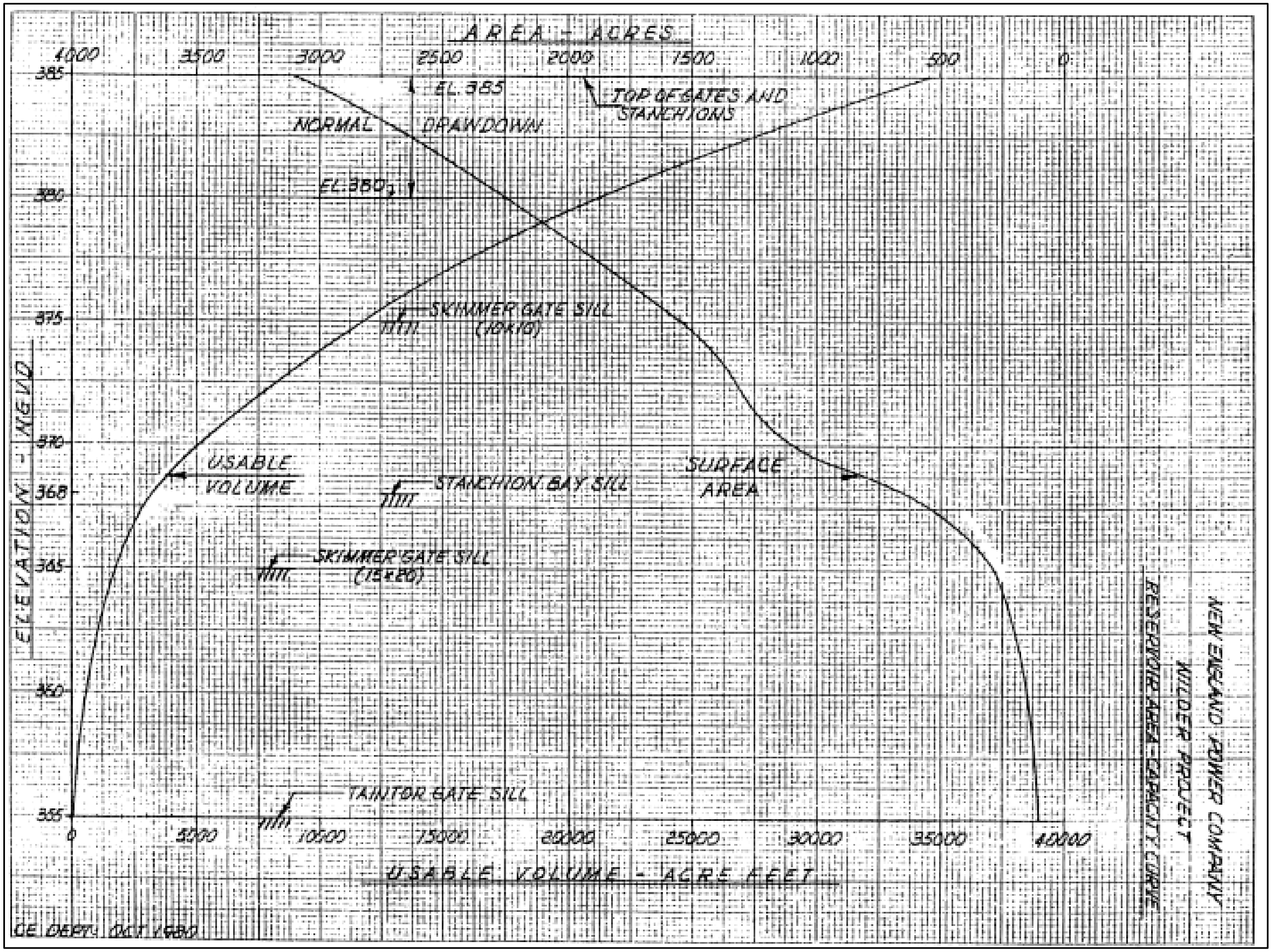

Figure 2.4-1. Reservoir capacity curve.

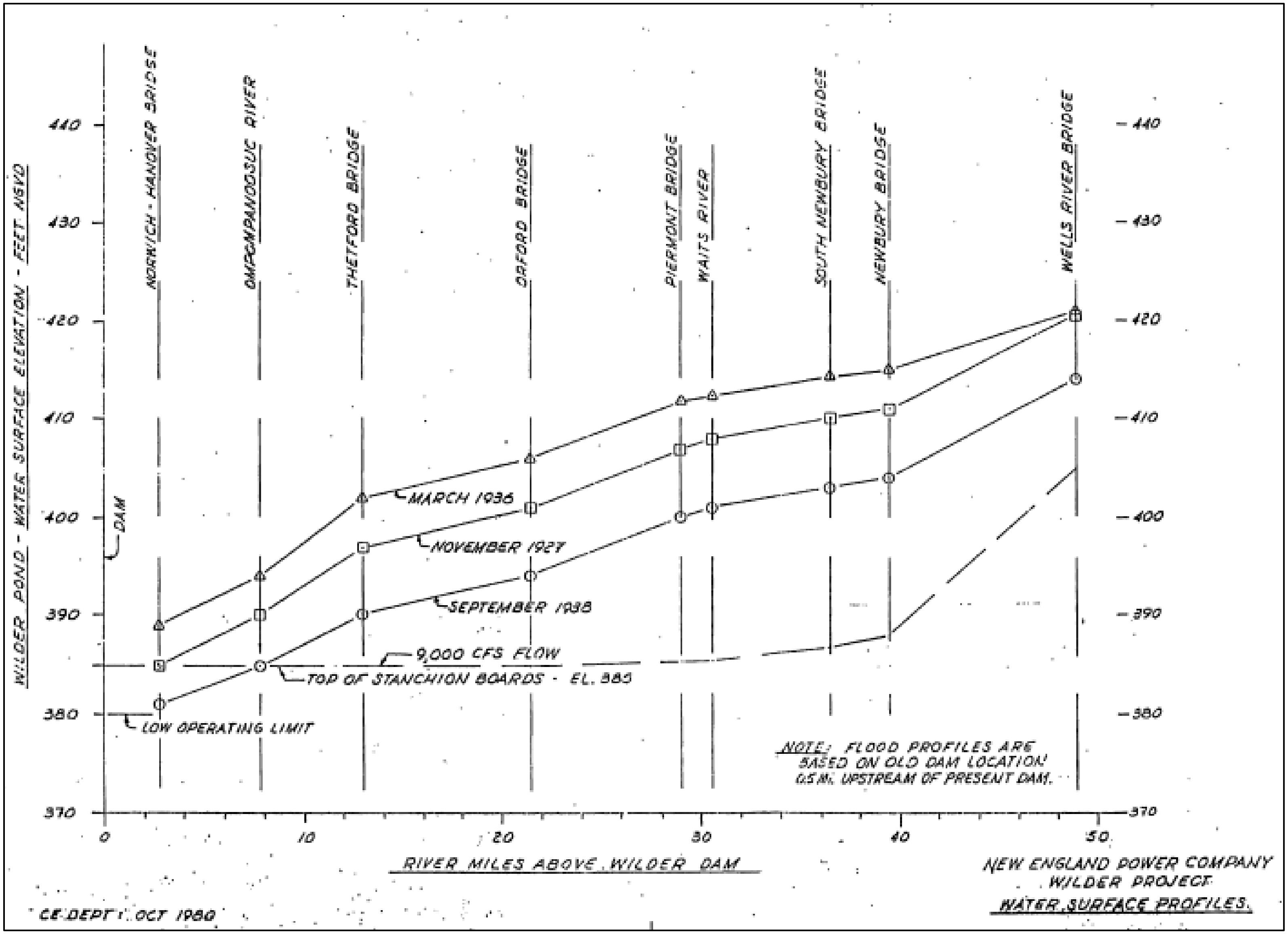

Figure 2.4-2. Water surface profiles.

Reservoir drawdown rates are typically less than 1 or 2-tenths of a foot per hour and do not exceed 3-tenths of a foot per hour based upon a self-imposed restriction documented in the operating procedures for Wilder. There is approximately 3,000 cfs per hour per 0.1 foot 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, the reservoir slope variability based upon inflow and constricted topography in certain locations, the Project operates in a "river profile" manner once flows exceed station capacity. See further information in section 2.5 below.

During the summer recreation season, beginning on the Friday before Memorial Day, through the last weekend in September, TransCanada maintains a self-imposed minimum reservoir elevation of 382.5 feet from Fridays at 4 pm through Sundays, at midnight. TransCanada maintains similar elevations for holidays during this period.

2.5 CURRENT PROJECT OPERATIONS

2.5.1 Basin Information

The drainage area above the dam is 3,375 square miles. Flows in this reach of river are influenced by the upstream hydroelectric projects under normal flow conditions. Approximately 1,165 square miles of the intermediate drainage area provides natural inflow into the Project beyond what is released from the upstream Fifteen Mile Falls Project (No. 2077). Four main tributaries the Ammonoosuc River in New Hampshire and the Wells River, Waits River and Ompompanoosuc River in Vermont, enter the Connecticut River between McIndoes dam and Wilder dam. See section 3.3, *River Basin Description*.

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.

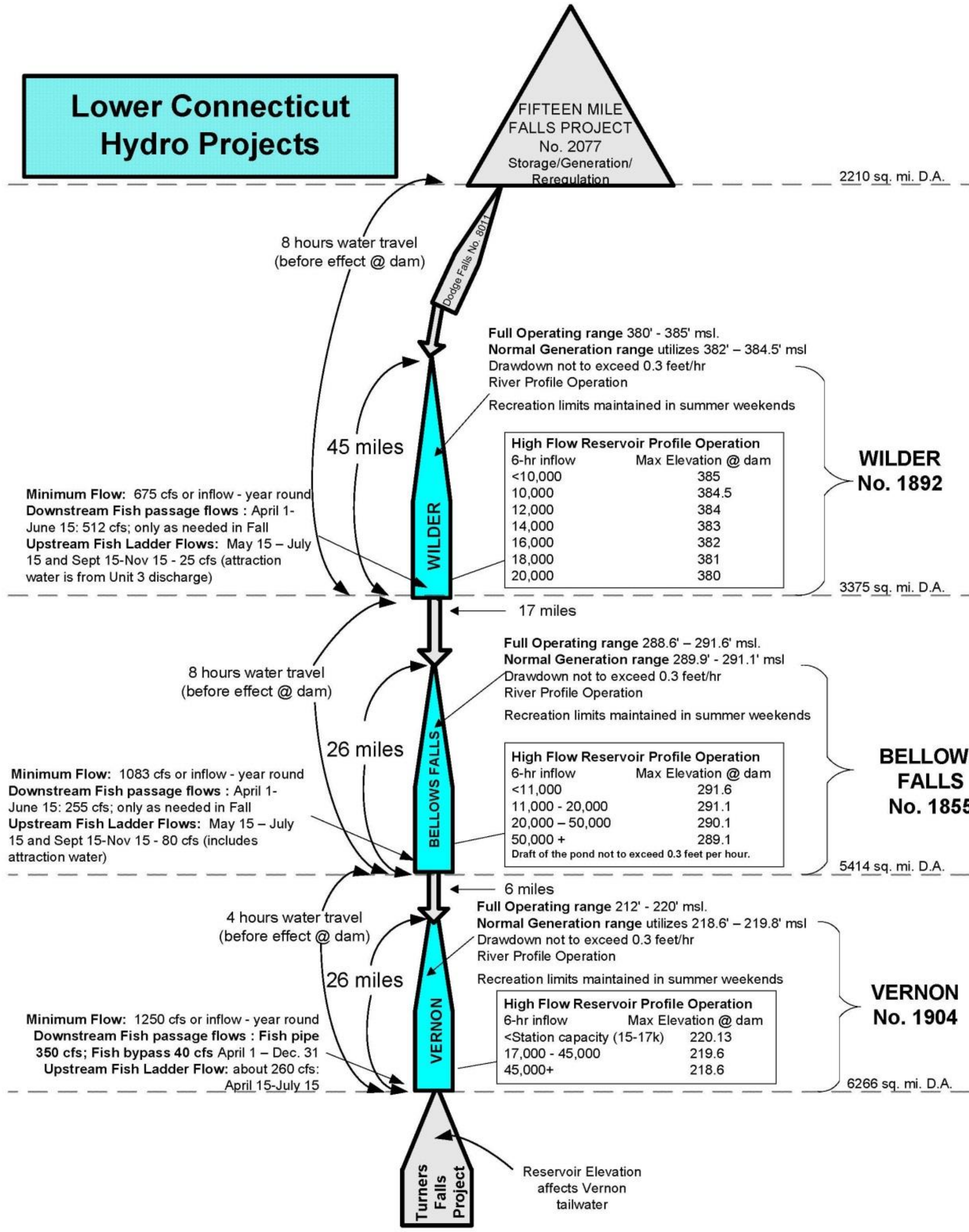

Figure 2.5-1. Connecticut River operations summary.

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 (ISO-NE). 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 675 cfs minimum flow (or inflow if less) is required. Minimum flow is provided primarily by Unit No. 3 at its efficient operating flow of about 700 cfs.

2.5.3 Inflow Calculation

Inflow into the Wilder Project is from two generalized sources: 1) discharge from the Fifteen Mile Falls Project (No. 2077) located 58 miles upstream, which operates two seasonal storage reservoirs influenced by 1,635 square miles of drainage area (above Comerford dam); and 2) natural inflow from the 1,740 square miles of intermediate drainage area between these storage reservoirs and Wilder dam.

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. Wilder Project inflow is estimated by combining the discharge from the Fifteen Mile Falls McIndoes Development and the intermediate flow between McIndoes and the mainstem gage on the Connecticut River between Wells River, Vermont, and Haverhill, New Hampshire. Additional inflow to the Project below this gage is estimated using net change in impoundment storage calculations in combination with readings from the gage on the Ompompanoosuc River. Inflows are typically calculated on an hourly basis. Inflow less than the required 675 cfs minimum is typically not determined since the Unit No. 3 generator is designed to operate efficiently at about 700 cfs flow.

2.5.4 River Profile Operation

The Wilder impoundment can be pre-drawn in advance of the inflow (between El. 385 and El. 380), 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 10,000 cfs.

When anticipated inflow into the Wilder impoundment increases above 10,000 cfs, TransCanada operators will initiate “river profile” operation by lowering the elevation at the dam. This pre-draw reservoir operation guideline results from a February 1949 Indenture and Flowage Easement with the Boston and Maine Railroad and from testimony given before the Federal Power Commission (predecessor of FERC) license hearings prior to the redevelopment of the Wilder Project. The purpose of this operation is to ensure that for flood flows up to the magnitude of those previously experienced (11,000 to 100,000 cfs), the backwater elevations with the new dam with the pond pre-drawn to El. 380 would not exceed those that would have occurred with the old dam. The 1949 Indenture and Flowage Easement with the Boston and Maine Railroad limits flowage onto railroad land for embankment protection at various mileposts to certain elevations based on the reservoir pre-drawn to El. 380.

There are five stages to the river profile operation corresponding to inflows above the 10,000 cfs range that have been established in order to operate the reservoir at elevation 380.0 when inflows exceed 20,000 cfs as summarized in table 2.5-1.

Table 2.5-1. River profile operating stages.

Anticipated Inflow	Maximum Elevation at the Dam
10,000 cfs	384.5
12,000 cfs	384.0
14,000 cfs	383.0
16,000 cfs	382.0
18,000 cfs	381.0
20,000 cfs	380.0

2.5.5 High Flow Operation

High flows, meaning flows above station capacity that require spill gate operation, occur at Wilder throughout the year. Annually, on average, flows at the dam exceed station capacity 17 percent of the time. There is little flood storage capacity within the Project and pre-spilling to create storage capacity does not routinely occur at Wilder. There may be instances however, where inflows are anticipated to peak at a level just above station capacity and the reservoir is drawn down ahead of these flows in order to capture the flow and avoid spilling, but such instances are uncommon as spill typically occurs. 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 to 0.2 foot per hour range. The timely anticipation of these events within operational constraints can minimize or eliminate spill, which results in the best use of the water resource.

Operations at the upstream Fifteen Mile Falls Project 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, is typically independent of upstream hydroelectric operation and is 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 below Wilder occurs distinctly earlier than runoff above Wilder dam but below the Fifteen Mile Falls Project. Spring runoff 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 reservoirs), reducing potential downstream high water conditions at Wilder 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 is observed, the station or tainter gate discharge must be increased to pass this temporary situation and to keep the reservoir elevation within its operating limits since there is no reservoir storage capacity in this circumstance. When ice moves from the White River into the Connecticut River, a jam may be created in the main channel at the Interstate 89 NH-VT bridge, which often causes a sharp rise in the Project's tailwater elevation requiring actions to secure and protect station equipment from tailrace flooding.

The Project spillway was designed to have a discharge capacity of approximately 160,000 cfs at normal full pond level, more than 75 percent greater than the maximum flood of record, 91,000 cfs occurring in March 1936 (prior to the 1950 Wilder re-development). Since the 1936 flood, the U.S. 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. The post-1936 construction of the USACE flood control dam on the Ompompanoosuc River at Union Village, Vermont, and TransCanada's Moore dam have significantly reduced flood potential at Wilder. Since re-development of the Wilder Project, the project has passed record flows of 50,400 cfs in March 1953 and July 1973. Both floods passed though the Project with an elevation of 380.0 at the dam. Station and spill capacity are provided in table 2.5-2.

Table 2.5-2. Project discharge capacity.

Station Capacity (cfs)	No Spill	EL. 380.0	EL. 381.0	EL. 382.0	EL. 383.0	EL. 384.0	EL. 385.0
3 generators	10,700	9,000	9,000	8,000	8,000	7,000	7,000
6 tainter gates	0	79,440	83,760	88,140	92,580	97,020	101,460
1 skimmer gate (15 X 20)	0	2,200	2,440	2,680	2,920	3,160	3,400
1 skimmer gate (10 X 10)	0	285	380	480	580	678	776

Station Capacity (cfs)	No Spill	EL. 380.0	EL. 381.0	EL. 382.0	EL. 383.0	EL. 384.0	EL. 385.0
4 stanchion bays[a]	0	0	0	0	0	41,200	44,960
Total Capacity	**10,700**	**90,925**	**95,580**	**99,300**	**104,080**	**149,058**	**157,596**

[a] Stanchions are not removed until flows exceed 145,000 cfs and the elevation reaches 384.0 (see below).

Spillway discharge at the dam is regulated by six tainter gates, two skimmer gates and four stanchion bays as described in section 2.3.1 above. The Nos. 3, 4, and 5 tainter gates can be operated by local or remote control. The Nos. 1, 2, and 6 tainter gates must be operated from the dam under the direction of the Connecticut River Operator.

Operating experience has shown that the tainter gate seals receive considerable damage from ice and debris if operated at small gate openings. For this reason low and high operating limits have been set for all tainter gates; however, this limit may be suspended if needed. The two skimmer gates are used as needed to remove pond debris. Due to their limited discharge capacity, they would not normally be used to pass flood flows until all tainter gates are committed. The normal power source to operate the skimmer and tainter gates is from the station service supply. A back-up supply is provided, by a diesel driven 175 KW generator located at the spillway to provide emergency power to any tainter gate 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 bay removal does not take place until flows exceed 145,000 cfs, all skimmer and tainter gates are fully open, and the pond elevation has reached El. 384. As inflow increases, stanchion bays are removed and tainter gates are closed as needed to control the reservoir elevation at El. 384 until all stanchion bays are cleared, thereby minimizing any downstream surges. If the flow continues to rise, any closed tainter gates are opened as needed to control the pond at El. 384 as long as possible.

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. One or more tainter gates are closed as stanchion sections are released to maintain a constant pond elevation and eliminate any downstream surge.

Table 2.5-3 below provides a summary of the Wilder Project high flow operation based upon increasing inflow into the project from upstream and tributary sources.

Table 2.5-3. High flow operations summary.

Wilder Natural Inflow	Project Status
10,000 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 FERC License Article 35 requires a minimum flow of 675 cfs from the Project and is supplied through either a hydro unit or a skimmer gate when power generation is unavailable.
10,000 to 20,000 cfs	When flows are in excess of the station capacity (10,700 cfs), all hydro units are wide open, and the spillway tainter gates operated to pass the excess flow. A limit placed on the pond elevation (river profile operation) to assure pond elevation 380.0 when station inflow reaches 20,000 cfs. The rate of draw or fill is determined to reach the desired elevation and a tainter gate is used to control 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 in anticipation of short duration, expected inflows to mitigate spilling, to the extent possible.
20,000 to 85,000 cfs	Inflows to the project in this range require all units wide open and the tainter gates operated to pass the excess flow. The pond limit is maintained at El. 380.0 and the tainter gates operated as necessary to maintain this elevation. The rate of draw is not to exceed 0.3 foot/hour under all conditions. No.1 tainter gate is a manual/remote operated gate. To maintain the reservoir operating range, the remaining five tainter gates are operated as directed by the operator. To protect the gate seals, each gate must be opened and pass approximately 1,100 cfs
85,000 to 145,000 cfs	Inflows in this range require all units wide open, all tainter gates opened and the skimmer and tainter gates operated to maintain the pond elevation to the extent possible. As flows increase above the maximum capacity of these gates, the pond will continue to rise. Stanchion boards are not removed until the pond level reaches El. 384.0. A section of boards might be removed if possible rather than tripping an entire bay. Stanchion bays are tripped sequentially as flows increase while the tainter gates are used to maintain the pond at El. 384.

Wilder Natural Inflow	Project Status
	Tainter gates are also adjusted to reduce overall discharge in advance of the large water release from entire stanchion bay removal to minimize downstream surge.
Expected to exceed 145,00 cfs	Flows in this range require all units wide open, all skimmer and tainter gates wide open, and the complete removal of all stanchion bays. From this point on there is no longer any control of flows at Wilder. Further inflow increases will raise the elevation at the dam and increase the spillway discharge.

2.5.6 Flood Control Coordination and Navigation

USACE maintains a flood control dam on the Ompompanoosuc River at Union Village, Vermont. USACE's Union Village dam can capture the stream flow from the 126 square miles of drainage area above it contributing to flood flows into this portion of the Connecticut River and Wilder reservoir.

Per Article 32 of the existing license, an agreement with the USACE provides for the coordinated operation of the Project with the USACE dam, 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.

The state of New Hampshire owns and operates Oliverian dam on the Oliverian Brook in Benton, New Hampshire. This dam, while important for flood control associated with this tributary, only captures stream flow from 10.6 square miles.

2.6 EXISTING LICENSE AND PROJECT OPERATIONS SUMMARY

2.6.1 Energy Production

Claimed capacity of the Project is 41.337 MW during the winter season and 41.073 during the summer season. Average annual gross energy production over the last 30 years (1982-2011) was 153,738 megawatt-hours (MWh). Average monthly gross energy production over the same time period varied from a low of 7,051 MWh in September to a high of 21,021 MWh in April.

Project monthly and annual generation and discharge since 2000 is summarized in tables 2.6-1 and 2.6-2; note 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	Total
2000	14,635	7,382	22,234	24,862	21,729	9,778	4,551	6,770	5,919	6,080	11,356	11,307	146,602
2001	10,289	8,059	8,004	16,753	14,380	10,026	6,830	3,298	3,082	3,479	5,810	7,103	97,114
2002	6,804	9,200	18,941	22,162	20,611	19,016	9,666	4,987	4,849	6,791	10,076	8,412	141,515
2003	7,925	5,762	11,073	19,507	18,214	8,947	5,631	8,606	6,810	13,298	20,636	20,522	146,931
2004	14,113	7,786	12,384	22,240	18,081	7,890	7,748	10,735	14,182	6,420	9,076	15,726	146,380
2005	13,733	7,029	9,274	21,132	19,929	16,499	10,211	4,900	7,662	18,436	21,144	16,354	166,302
2006	21,295	15,412	13,699	19,863	15,888	17,876	15,265	13,476	6,337	14,707	20,154	17,411	191,383
2007	16,634	7,538	15,460	21,752	20,055	8,690	10,274	6,542	6,282	12,251	18,063	14,399	157,940
2008	16,236	12,960	20,671	21,555	15,583	16,375	15,208	20,600	7,933	11,116	16,337	18,978	193,550
2009	13,630	9,529	21,529	22,075	20,844	11,365	20,265	15,078	5,130	12,198	16,809	17,101	185,552
2010	13,870	11,420	19,249	22,923	16,480	10,838	7,186	8,450	4,988	21,968	18,557	17,737	173,664
2011	11,254	8,092	19,041	17,220	22,706	12,758	6,451	8,040	15,559	19,157	10,828	15,324	166,430
2012	11,773	8,963	17,702	14,041	20,651	12,731	7,660	5,037	6,081				104,640
Average	13,245	9,164	16,097	20,468	18,858	12,522	9,765	8,963	7,293	12,158[a]	14,904[a]	15,031[a]	158,469

[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	4997	3500	2477	2799	5331	5044	9897	6652	6737	4813	5046	4009	5109
2001	2940	3188	3706	2236	2806	2839	6918	3021	5167	3758	4475	3147	3318
2002	10016	2938	7499	6182	5343	3440	5327	6692	8370	8806	9664	7664	8622
2003	17258	14612	16458	9331	11530	16575	8179	14693	19931	12437	10968	18024	6195
2004	13071	6593	8869	8087	7732	8609	8977	9950	7204	8270	6543	15918	8661
2005	3998	4027	9837	3412	3372	8039	9876	3528	6707	4925	4345	5309	5288
2006	1901	2377	3625	2002	2871	3495	5624	3708	7969	8052	2609	2165	2385
2007	2387	1208	1753	3155	4049	1822	5103	2297	11105	5419	3014	4532	1777
2008	2129	1112	1723	2540	5338	2898	2412	2193	2743	1824	1968	5968	2737
2009	2270	1297	2379	7067	2194	12675	7534	4866	4333	5184	11460	7447	5726
2010	4199	2195	3647	10365	3682	11018	8504	7761	6002	6304	7769	3641	6257
2011	5198	2436	3236	10761	5924	7615	7446	5186	7500	8042	6948	6120	6368
2012	4099	3318	8622	6195	8661	5288	2385	1777	2186				
Average	5728	3754	5679	5702	5295	6874	6783	5563	7381	6486[a]	6234[a]	699[a]	5204[a]

a Average of 2000 – 2011 only.

2.6.3 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 Wilder Project as of December 31, 2011, was $50,616,701. 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 through the end of 2011.

2.6.4 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 (December 11, 1985 amendment)	Requires payment of annual charges to the Commission for the cost of administration of the license, based on the authorized installed capacity (including the 1985 addition of the third generating unit) for that purpose of 47,500 horsepower.
31	Requires implementing and modifying when appropriate, the emergency action plan on file with the Commission designed to provide an early warning to upstream and downstream inhabitants and property owners if there should be an impending or actual sudden release of water caused by an accident to, or failure of, Project works.
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 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.
34 (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 Commission approval.
35	Requires the Licensee to maintain a continuous minimum flow of 675 cfs (0.20 cubic feet per second per square mile of drainage basin) or a discharge flow equal to the inflow of the reservoir, whichever is less, from the Project into the Connecticut River. These flows may be modified temporarily: (1) during and to the extent required by operating emergencies beyond the control of the Licensee; and (2) in

License Article	Summary of Requirement
	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.
36	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.
37	Requires filing with the Commission a feasibility analysis of installing additional generating capacity at the Project.
38	Required filing revised Exhibit K drawings clearly delineating the limits of the lands over which the Licensee holds flowage rights for the Project.

2.6.5 Compliance History

The Licensee for the Project is aware of only two instances of non-compliance with the conditions of the Project license and both occurred when the Project was owned and operated by a previous Licensee.

On December 17, 2002, the Commission issued a notice of a license violation related to the Licensee's failure to conduct and submit a tainter gate analysis under Part 12. That analysis was subsequently conducted and submitted to the Commission on March 27, 2003.

On December 9, 1987, the Commission issued a notice of a license violation related to a then revised schedule for construction of fish passage facilities. Upstream and downstream passage facilities were completed and first operated in the spring of 1987, and in June of 1988 respectively.

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 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) 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).

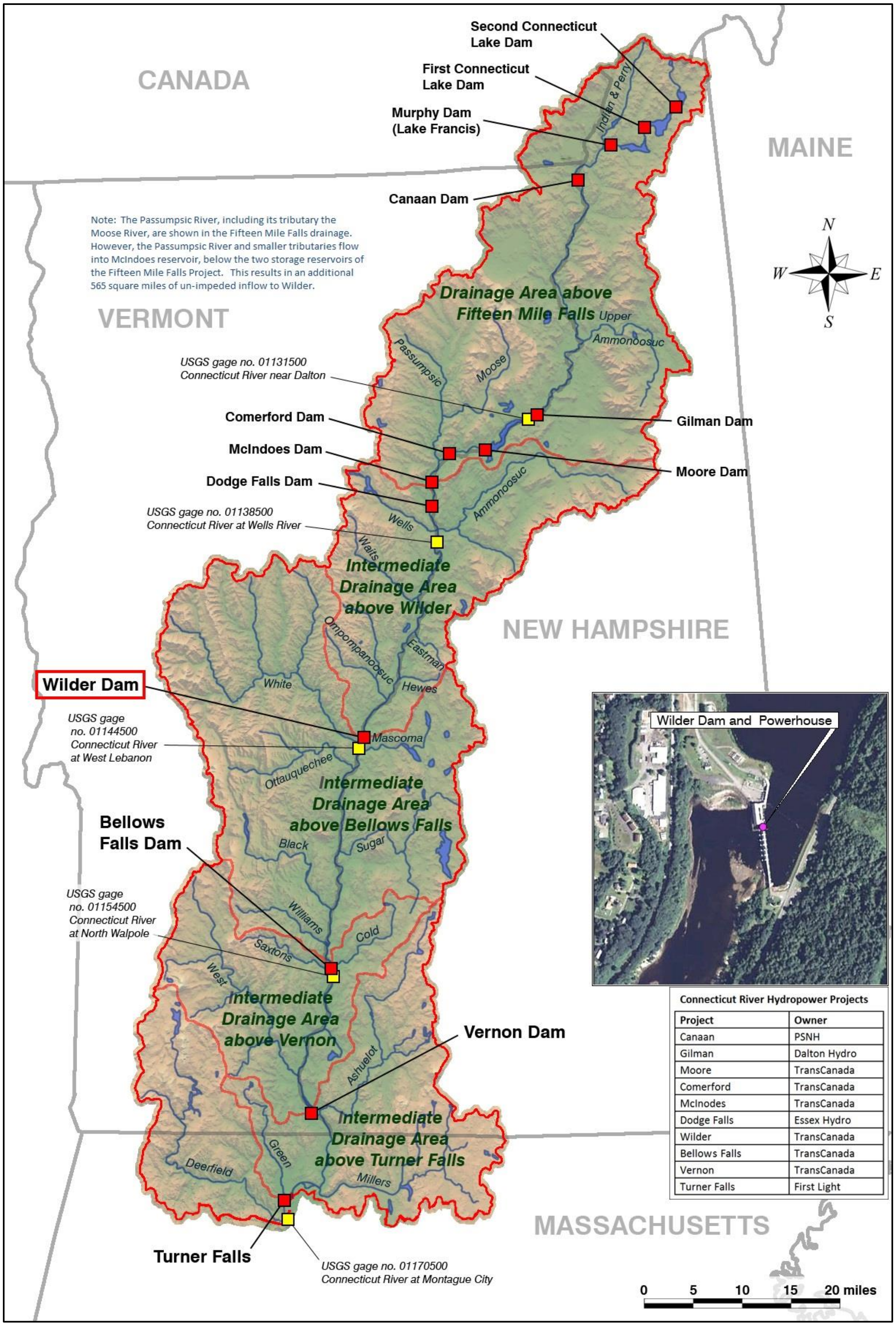
Throughout this section as we discuss the existing environment and resources, we use the following specific terms:

- 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.
- Wilder Project affected area: Wilder impoundment to the upstream extent of Bellows Falls 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 [FERC No. 1889] in Massachusetts) is about 271 miles long.

[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.



Project	Owner
Canaan	PSNH
Gilman	Dalton Hydro
Moore	TransCanada
Comerford	TransCanada
McIndoes	TransCanada
Dodge Falls	Essex Hydro
Wilder	TransCanada
Bellows Falls	TransCanada
Vernon	TransCanada
Turner Falls	First Light

Figure 3.2-1. Project and the upper Connecticut River Basin (Source: EPA, 2012, as modified by staff).

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, 87 miles upstream of the mouth of the Connecticut River at Long Island Sound, is Holyoke dam, in Holyoke, Massachusetts. Major tributaries affecting the Wilder, Bellows Falls, and Vernon projects downstream of the storage reservoirs of Comerford and Moore dams include the Passumpsic, Waits, Ompompanoosuc, White, Ottaquechee, Black, Williams, and West rivers in Vermont, and the Ammonoosuc, Mascoma, Sugar, and Cold rivers in New Hampshire.

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 with 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 Orange County, Vermont, and the northern reaches of Grafton 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). Similarly, dams constructed for industrial mill power and transportation also pre-dated large-scale hydroelectric development. Building of the large mainstem hydroelectric dams on the Connecticut River started with the completion of two downstream projects - Vernon dam and powerhouse in 1909, and the Bellows Falls Project in 1928. The upstream Fifteen Mile Falls Project, consisting of McIndoes, Comerford, and Moore dams, was constructed between the 1930s and 1950s. The Wilder Project, constructed in 1950, was a redevelopment of a site occupied by a paper mill and hydroelectric plant. 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, and there are municipal water supply wells in the groundwater aquifer next to the river in Hanover, New Hampshire. 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 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 operates dams at First and Second Connecticut Lakes as water storage facilities. The state of New Hampshire owns Murphy dam for storage. 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 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 vicinity of the Project.

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

Tributary	Town, State	Drainage Area (square miles)	Enters Connecticut River at River Mile
Upstream of Wilder dam			
Passumpsic River	East Barnet, VT	507	280
Ammonoosuc River	Woodsville, NH	395	266
Wells River	Wells River, VT	100	266
Waits River	Bradford, VT	158	246.8
Ompompanoosuc River	Pompanoosuc, VT	136	224.3
Downstream of Wilder Project and above Bellows Falls project			
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

Note: Upstream of Wilder dam in this context does not include tributaries that are affected by mainstem storage such as at the Fifteen Mile Falls Project.

Passumpsic River

The Passumpsic River drains portions of Caledonia, Washington, Essex, and Orleans counties in northeastern Vermont. The river flows generally southward, and the Moose River joins in St. Johnsbury. The Passumpsic River continues southward and enters the Connecticut River in the McIndoes reservoir at East Barnet, below the two storage reservoirs (Moore and Comerford) associated with TransCanada's Fifteen Mile Falls Project. There are numerous dams on the Passumpsic River, including hydropower projects, but all have very small impoundments without the ability to affect high flows. The last dam of the Passumpsic River is owned by Central Vermont Public Service and is located less than one mile upstream of the Connecticut River. The main stem of the river is about 23 miles long and has a drainage area of 507 square miles (Vermont ANR, 2009; FWS. 2010).

Ammonoosuc River

The Ammonoosuc River originates on the western slopes of the Presidential Range in the White Mountains; flows westward and then southwest through the towns of Carroll, Bethlehem, Littleton, Lisbon, Landaff, Bath, and Haverhill, New Hampshire; and enters the Connecticut River in Woodsville, New Hampshire. The Ammonoosuc River is largely free-flowing, with only small impoundments behind the Woodsville, Bath, Lisbon and Apthrop dams and the dam at Woodsville is only about 0.1 mile upstream from the Connecticut River. The river is about 55 miles long and has a drainage area of about 395 square miles (New Hampshire DES, 2012; FWS, 2010)

Wells River

The Wells River originates in the town of Groton in southwestern Caledonia County, Vermont; flows southeast through the towns of Ryegate and Newbury, Vermont; and enters the Connecticut River in Wells River, Vermont. The first dam is about 0.8 RM above the confluence with the Connecticut River is the Newbury dam (FERC No. 5261) in Wells River, Vt. The river is about 15 miles long and has a drainage area of about 100 square miles (CRJC, 2009a; FWS, 2012).

Waits River

The Waits River originates in southwestern Caledonia County, Vermont, and flows southeasterly through the towns of Orange, Topsham, and Corinth, Vermont, before entering the Connecticut River in the town of Bradford, Vermont. The first dam, which is about 1 RM above the confluence with the Connecticut River, is the Bradford dam (FERC No. 2488) in Bradford, Vermont. The river is about 25 miles long and has a drainage area of about 158 square miles (CRJC, 2009b; FWS, 2010).

Ompompanoosuc River

The Ompompanoosuc River originates in eastern Orange County, Vermont, and flows southward through the towns of West Fairlee and Thetford, Vermont, into Windsor County and enters the Connecticut River in the town of Norwich, Vermont. Union Village dam, a USACE flood control project, was built in the town of Thetford in 1950 and is about 4 RM above the confluence with the Connecticut River. The river is about 25 miles long with a drainage area of 136 square miles (CRJC, 2009b; FWS, 2010)

White River

The White River originates in the Green Mountains of Vermont 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, and Hartford, Vermont, and enters the Connecticut River at White River Junction. The river does not have any dams on its main stem, is the largest tributary to the Connecticut River (710 square mile drainage area), and is 60 miles long (CRJC, 2009b; FWS, 2010).

Mascoma River

The Mascoma River originates in the town of Dorchester, New Hampshire, in Grafton County; flows south and west thorough the towns of Canaan and Enfield, New Hampshire; and flows into the Connecticut River in Lebanon, New Hampshire. In its lower sections, the river has numerous small storage and hydropower dam 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 with 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, Vermont, before joining the Connecticut River in Hartland, Vermont. North Hartland Lake, a USACE flood control dam, is located on the river about 1.5 river miles upstream of the confluence with the Connecticut River. 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 with a drainage area of 222 square miles (CRJC, 2009c; FWS, 2010).

Flows in the Connecticut River and major tributaries to the river in the Project area are (or were) measured at the USGS gages shown in table 3.3-4. In addition to the USGS gages, TransCanada records reservoir levels, generation, and discharges continuously at the Wilder Project.

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

Site Number	Site Name	Data	Drainage area
Upstream of Wilder dam			
01138500	Connecticut River at Wells River, VT (this gage is located above the upper limit of Wilder reservoir)	12-14-49 to present	2,644
01141500	Ompompanoosuc River at Union Village, VT	09-21-40 to 09-30-89 and 04-30-12 to present	130
Downstream of Wilder dam and above Bellows Falls Project			
01144000	White River at West Hartford, VT	06-09-15 to present	690
01144500	Connecticut River at West Lebanon, NH	11-01-1911 present	4092
01150500	Mascoma River at Mascoma, NH	08-16-1923 to 09-30-2004	153
01151500	Ottauquechee River At North Hartland, VT	10-01-30 to present	221

3.3.3 Climate

The Project area near Wilder has mild and humid summers and cold winters. Average July temperatures range from a daily average maximum of 81 degrees Fahrenheit (°F) and a daily average minimum of 57° F. Average January temperatures range from a daily average maximum of 29° F and a daily average minimum of 8° F. The average annual precipitation of 36.2 inches 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

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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 Wilder 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 Orange County, Vermont (USDA, 1978).
- 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).
- Natural Resource Conservation Service – Web Soil Survey (NRCS, 2012).
- 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 eastern Vermont and western New Hampshire, the Project area lies in the 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 400 to 500 feet. The upland hills adjacent to river terraces generally range from elevation 500 to 1,000 feet.

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, and at the foot of the White Mountains in New Hampshire to the east. 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.

3.4.3 Geological Features

Geologically, the Project lies along the Bronson Hill Province, which takes up the eastern third to half of the state of Vermont and forms the western border of New Hampshire. The Bronson Hill terrain initially formed during the Ordovician period Taconic orogeny as a volcanic island arc that developed through subduction of the eastern edge of the Laurentian plate. Bedrock deposits include metamorphosed volcanics and sedimentary deposits associated with the Oxfordville and Albec formations that include Cambrian and Silurian schist, quartzite, slate, granofels, phyllite, amphibolites, hornfels, gneiss, and felsite.

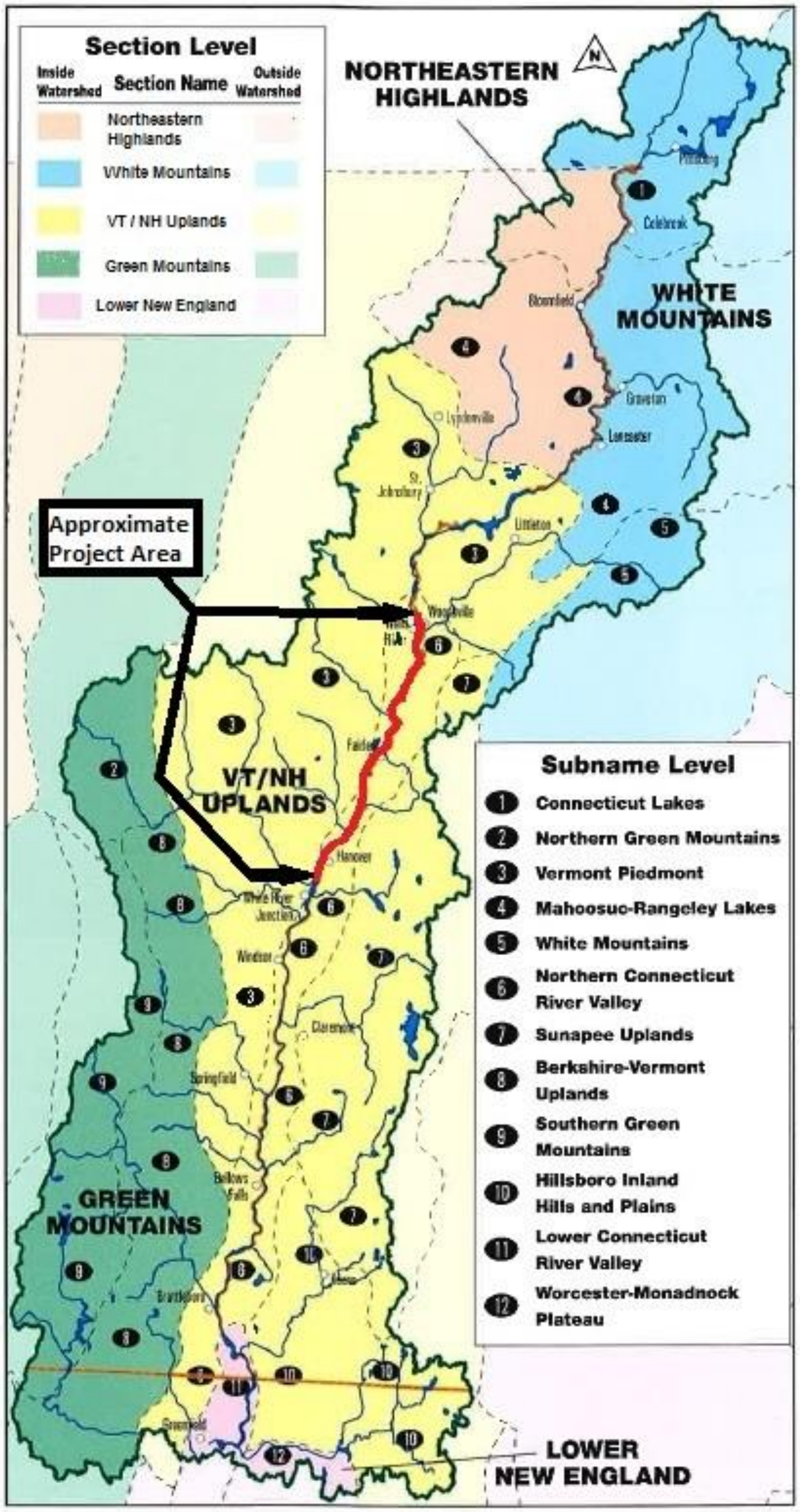

Figure 3.4-1. Physiographic regions of Vermont and New Hampshire showing the Project area (Source: Brown, 2009).

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 and moraines 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 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 200 miles from Rocky Hill to St. Johnsbury, Vermont, and reached 20 miles in width. 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 in the Project. Soil types situated on terrace formations along the Connecticut River include loamy sands and sandy loams associated with the Quonset, Windsor, Agawam, Merrimac, and Ninigret series. These soils formed from deposits laid down as glacial outwash. Silt loams associated with the Hitchcock, Belgrade, and Hartland 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. 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, and gravel 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, Woodstock, and Colrain soil series, Buckland loam series, and silt loams associated with the Bernardson, Cardigan, and Pittstown soil series. Other soil types present in upland area include the Glover-Vershire complex. These soils can often consist of a rocky to very rocky shallow mantle overlying bedrock, and are frequently interspersed with bedrock outcrops. Udorthent and Udipsamment soil types are also present along the Project area 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 existing Wilder impoundment was created from 1947 to 1950 with the completion of the hydroelectric facility dam between Wilder village (Hartford), Vermont, and West Lebanon, New Hampshire. Flooding of the river shorelines upstream to the Project terminus at the Oxbow in Newbury, Vermont, resulted in the widening of the river channel in low-lying areas to about elevation 385 feet, as can be discerned from pre-dam construction town and USGS maps.

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 Wilder impoundment was evaluated in this study, which discussed the various processes that occur along the Connecticut River. The study emphasized two categories of forces that affect the shoreline: (1) those forces that act on or near the surface of the water associated with pool fluctuations; related piping; groundwater; wind waves; boat waves; ice; lack of, or removal of, vegetation; 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 submerged bank by the flowing water. Under these circumstances, the maximum force acting on the bank is submerged a considerable distance below the water surface and 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 Wilder 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 (2011) reported 100 locations of bank erosion in the Project, with 77 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, surface run-off of rainwater, removal or loss of vegetation, obstacles in the river (e.g., docks, marinas, retaining walls, boat launches, bridge abutments), and waves and boat wakes. All reported erosion areas in the Project were examined during the 2011 Phase 1A survey (PAL, 2012).

The Project is operated in a daily cycle "run-of-river" mode, where daily inflow matches daily outflow. This may result in modest daily pond fluctuations due to upstream Project-related generation, mainly at the downstream end of the Wilder reservoir due to the "pitch" of the river, but relatively constant water levels are maintained. The Wilder impoundment level is normally operated between elevations 382.0 feet (msl) and 384.5 feet (msl), although the license currently allows operation between elevation 380.0 feet (msl) and 385.0 feet (msl). The 2010 shoreline survey and the 1979 streambank erosion study conducted for the USACE concluded that Project operations would not likely be a significant contributor to erosion in the reservoir compared to naturally occurring high river flows coupled with highly susceptible soils (Kleinschmidt, 2011; Simons et al., 1979). During high flow periods, Wilder is operated to minimize flooding via impoundment drawdown to maintain reservoir elevation to the extent possible. Agricultural use along the shoreline and Project boundary was determined to be a contributing factor to erosion coupled with the moderate level 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 reservoir shoreline upstream of the Wilder 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. The storm likely contributed to an increase in the severity of erosion in the areas that were already noted during the 2010 shoreline study report (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. Indeed, all nine pre-contact sites identified during the course of the Phase 1A survey were found in eroding banks below cultivated fields. Two others were on steep slopes in proximity to the railroad tracks on the Vermont side of the river.

The maintenance of adequate vegetated riparian buffer zones has proven 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 Water Quality Protection Act (RSA 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 Water Quality 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 and cultivate 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

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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 quantity resources at, or in the vicinity of, the Wilder 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 Wilder Project from TransCanada;
- Operational procedures for the Wilder 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 Commission. 2009;
- Water Resources, Upper Valley Region. 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 (draft);
- Vermont DEC Surface Water Quality Assessments 305(b) and 303(d) reports 2012;
- New Hampshire DES 2004 Connecticut River Water Quality Assessment Project;
- CRJC River Management Plans and Water Resources Management Plans;
- USGS National Water Quality Assessment 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; and
- TransCanada and Normandeau Associates 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 the 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 Wilder Project is located at RM 217.4, and the reservoir extends about 45 miles upstream. The depth of the reservoir at low flow conditions ranges from several feet at the upper end to about 60 feet near the dam. Water released from the project flows into the Bellows Falls reservoir, the upper reaches of which are located about 17.7 river miles downstream of Wilder dam.

Drainage Area

The Wilder reservoir extends northward to Newbury in Orange County, Vermont, and Haverhill in Grafton County, New Hampshire. The reservoir has a total drainage area of 3,375 square miles and a surface area of about 3,100 acres and is about 46 miles long with a shoreline of more than 90 miles. Farther upstream on the Connecticut River are two large storage reservoirs associated with the upstream Fifteen Mile Falls Project. Of the total Connecticut River drainage area upstream of the Wilder dam, 1,740 square miles or more than 51 percent of the total enters as unmanaged inflow below Comerford dam except under flood flow conditions when the USACE dam on the Omponpanoosuc River stores water temporarily. See section 3.2, *General Description of the Watershed*, for further information about the river basin.

Reservoir Characteristics

Wilder reservoir has a total water storage volume of 34,600 acre-feet. The licensed operating range of the Project is from a minimum elevation of 380.0 feet to a maximum of 385.0 feet, but the normal operating range (non-spill, non-emergency operation conditions) is between elevation 382.0 and 384.5 feet. There is about 13,350 acre-feet of usable storage in the 5 feet of operating range, representing less than half of the volume of the average daily inflow during April, the month with the highest average monthly inflow. Wilder reservoir is riverine in character and ranges in depths from several feet to about 60 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 11 feet, and it has a flushing rate of slightly less than 3 days based on the average flow of about 6,400 cfs. The substrate of Wilder reservoir ranges from generally sand, silt, and gravel in the lower end of the reservoir and coarser substrate in the upper reaches of the reservoir (Biodrawversity and LBG, draft 2012). The maximum discharge capacity is 157,600 cfs, and the flood of record at this site, which occurred in March 1936, was 91,000 cfs. Since then, numerous USACE flood control structures have been built, as well as Moore dam (which has some flood control capability), and these have helped to decrease the peak flow during flood events. Since Moore dam started operation in the late 1950s, the highest flow recorded at Wilder has been less than 65,000 cfs.

Reservoir levels are set in relation to anticipated inflows. If anticipated inflows are likely to exceed the station capacity of 10,700 cfs, TransCanada normally pre-draws the reservoir by opening one or more tainter gates to limit the reservoir levels at the dam as shown in table 3.5-1.

Table 3.5-1. Reservoir levels and anticipated inflows (Source: TransCanada).

Anticipated inflows (cfs)	Maximum Reservoir Elevation (feet msl)
10,000	384.5
12,000	384.0
14,000	383.0
16,000	382.0
18,000	381.0
20,000	380.0
In excess of 20,000	380.0

If the reservoir level continues to rise to elevation 384.5 feet, the stanchion bays are tripped to maintain the pond elevation at 384.5 feet as long as possible. Figure 3.5-1 shows a bar and whisker graph with hourly median, average, minimum, maximum, and the 5, 25, 75, and 95 percent exceedence values for reservoir levels from January 1, 2011, to December 31, 2011. This graph shows compliance with the operational range and how the reservoir is lowered at the dam in April when flows in excess of 10,700 cfs are common. Lowering the reservoir level during high flow conditions at the dam helps decrease the water level in the upper reaches of the reservoir backwater effects and in the riverine reach above the reservoir to levels lower than what would exist otherwise. TransCanada limits the reservoir drawdown rate to no more than 0.3 foot per hour.

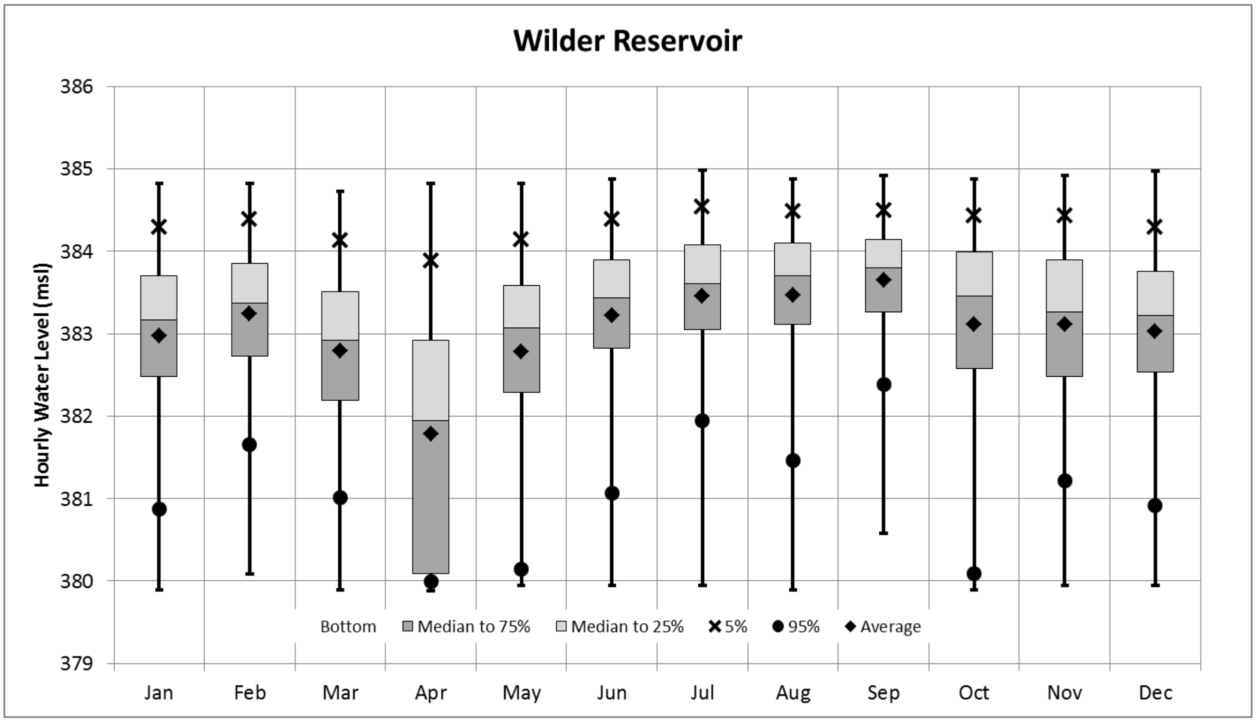

Figure 3.5-1. Project reservoir levels for January 1, 2001, to December 31, 2011 (Source: TransCanada, 2012).

Project Inflow and Outflow

Under normal generation conditions, it takes about 8 hours for flow releases from the upstream McIndoes dam to reach Wilder dam and about 8 hours for releases from Wilder dam to reach Bellows Falls dam. The small run-of-river Dodge Falls Project (FERC No. 8011) is located about 51 river miles above Wilder and has limited effects on travel times from McIndoes dam. Figures 3.5-2 through 3.5-5 provide monthly exceedence curves for the Wilder Project based on two USGS gages in the project vicinity; USGS gage no. 01144500 Connecticut River at West Lebanon, New Hampshire, located downstream of the confluence with the White River and USGS gage no. 01144000 White River at West Hartford, Vermont, located a short distance upstream on the White River. To estimate flow from only the Wilder Project, the daily flow from the White River gage was prorated by 1.039. These daily prorated flow values were used to account for the small amount of the White River drainage area that is not captured by this gage and for the small tributaries that enter the Connecticut River above the West Lebanon gage. For each day, the daily average flows from the prorated values from the White River gage were then subtracted from the daily West Lebanon gage to estimate flows from the Wilder Project. Table 3.5-2 summarizes the monthly minimum, average, and maximum monthly values for the same data set as the exceedence curves.

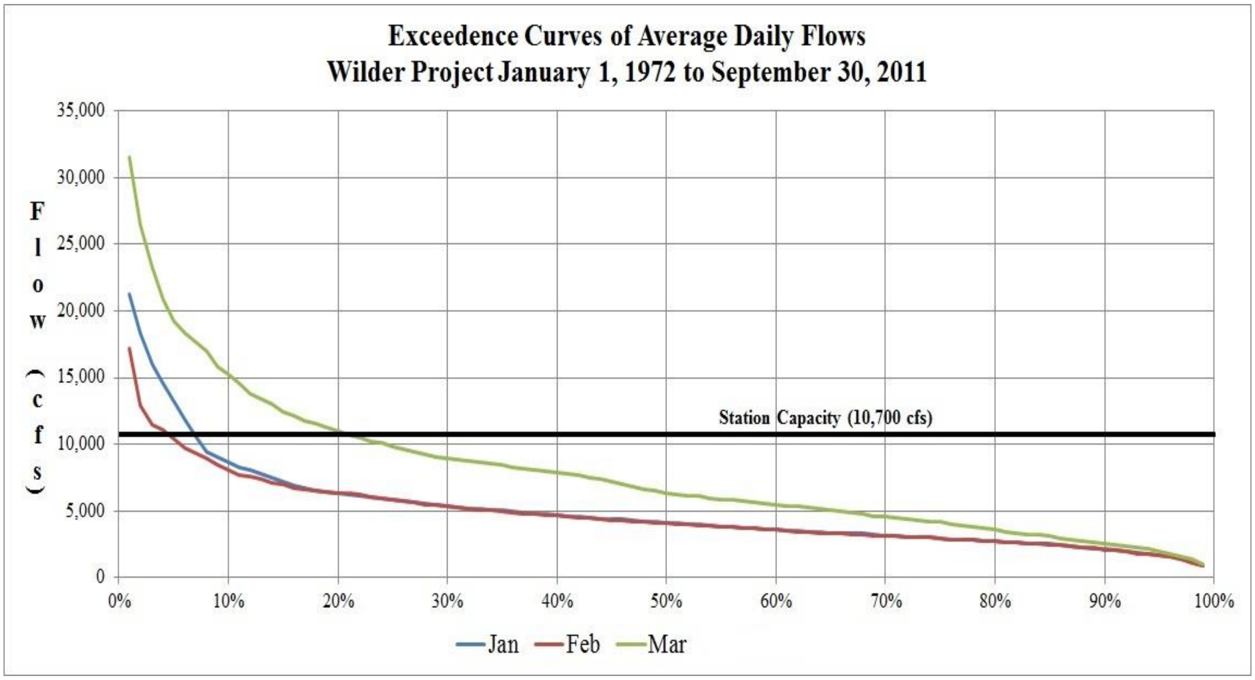

Figure 3.5-2. Exceedence curves for January, February, and March (Source: USGS, 2012, as modified by TransCanada).

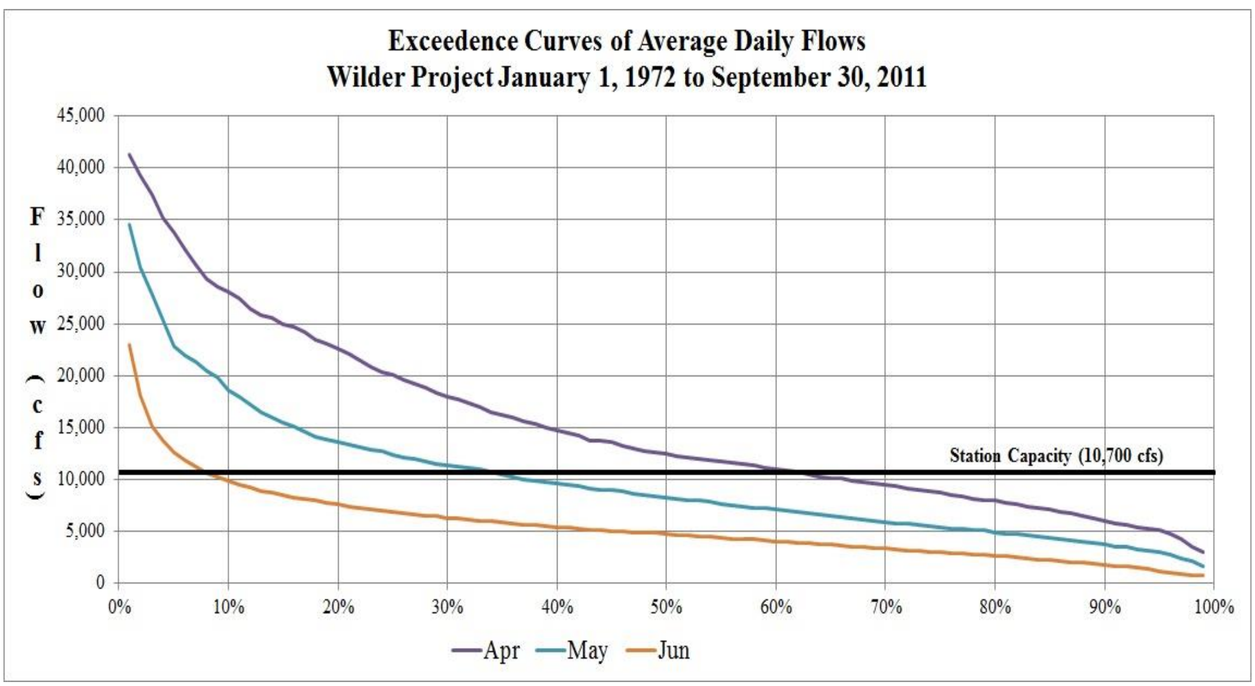

Figure 3.5-3. Exceedence curves for April, May, and June (Source: USGS, 2012, as modified by TransCanada).

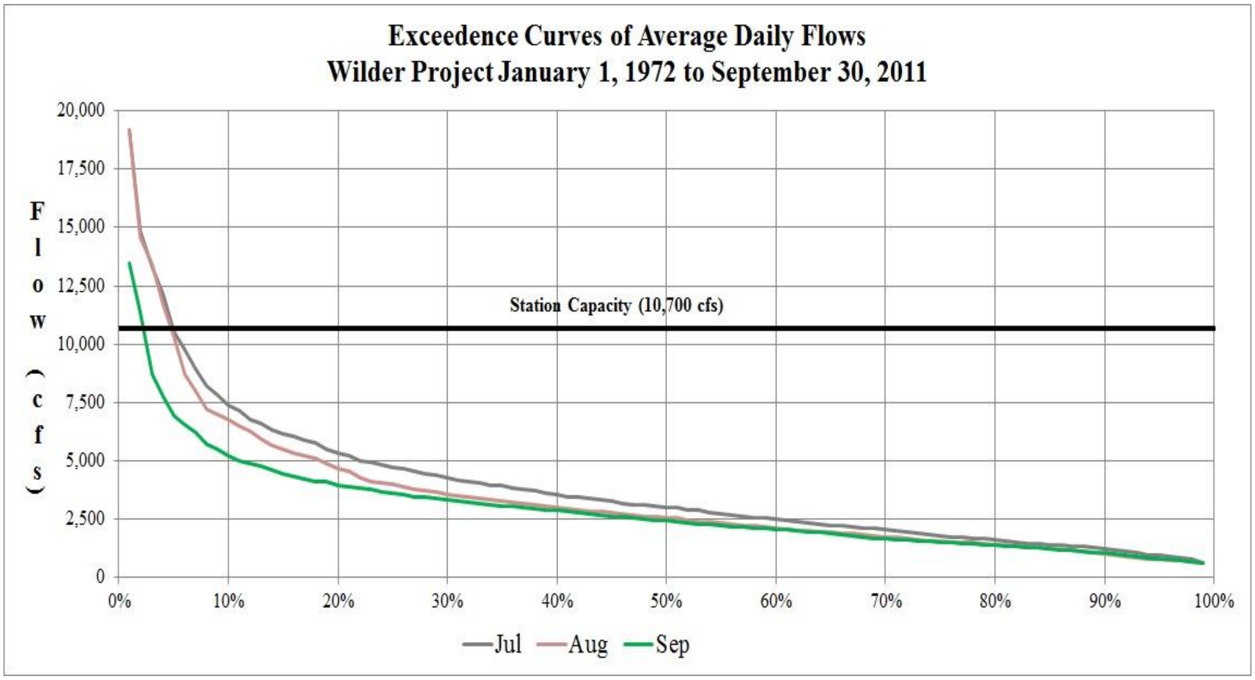

Figure 3.5-4. Exceedence curves for July, August, and September (Source: USGS, 2012, as modified by TransCanada).

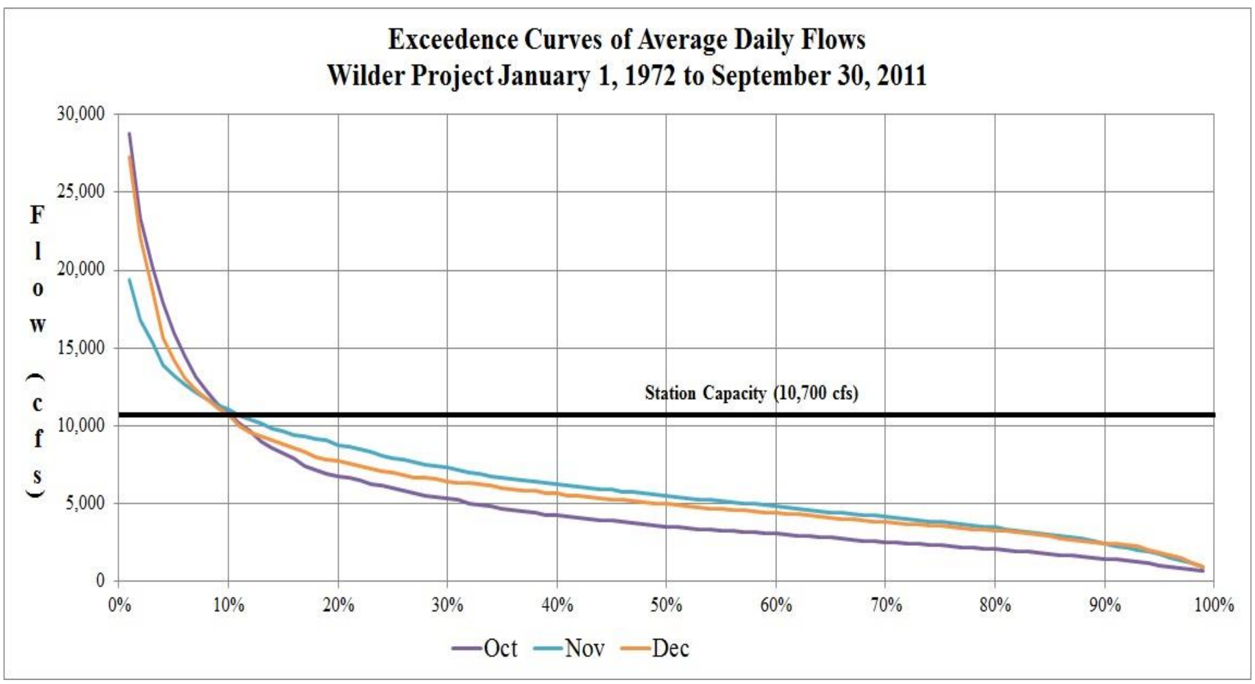

Figure 3.5-5. Exceedence curves for October, November, and December (Source: USGS, 2012, as modified by TransCanada).

Table 3.5-2. Monthly minimum, average, and maximum flow values (cfs) (Source: USGS, 2012, as modified by TransCanada).

Month	Minimum	Year	Average	Maximum	Year
January	2,004	1981	5,099	11,319	2006
February	1,797	1980	4,824	14,011	1981
March	3,141	2001	7,965	18,315	1979
April	4,360	1995	15,201	23,140	2008
May	3,710	1987	9,999	21,328	1972
June	1,991	1999	5,631	12,966	1984
July	1,474	1995	4,036	12,241	1973
August	1,233	2001	3,537	12,949	2008
September	1,131	2001	3,002	7,004	2011
October	1,299	2001	5,240	15,260	2005
November	2,229	2001	6,340	13,416	2005
December	1,775	1978	6,113	13,578	1983

When inflows are less than the station capacity of 10,700 cfs, TransCanada operates the Project as a peaking project to help meet regional electrical demand. During all times, TransCanada’s first priority is meeting the minimum flow requirement of 675 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 10,700 cfs other than during high flow events that are most common in the spring and early fall.

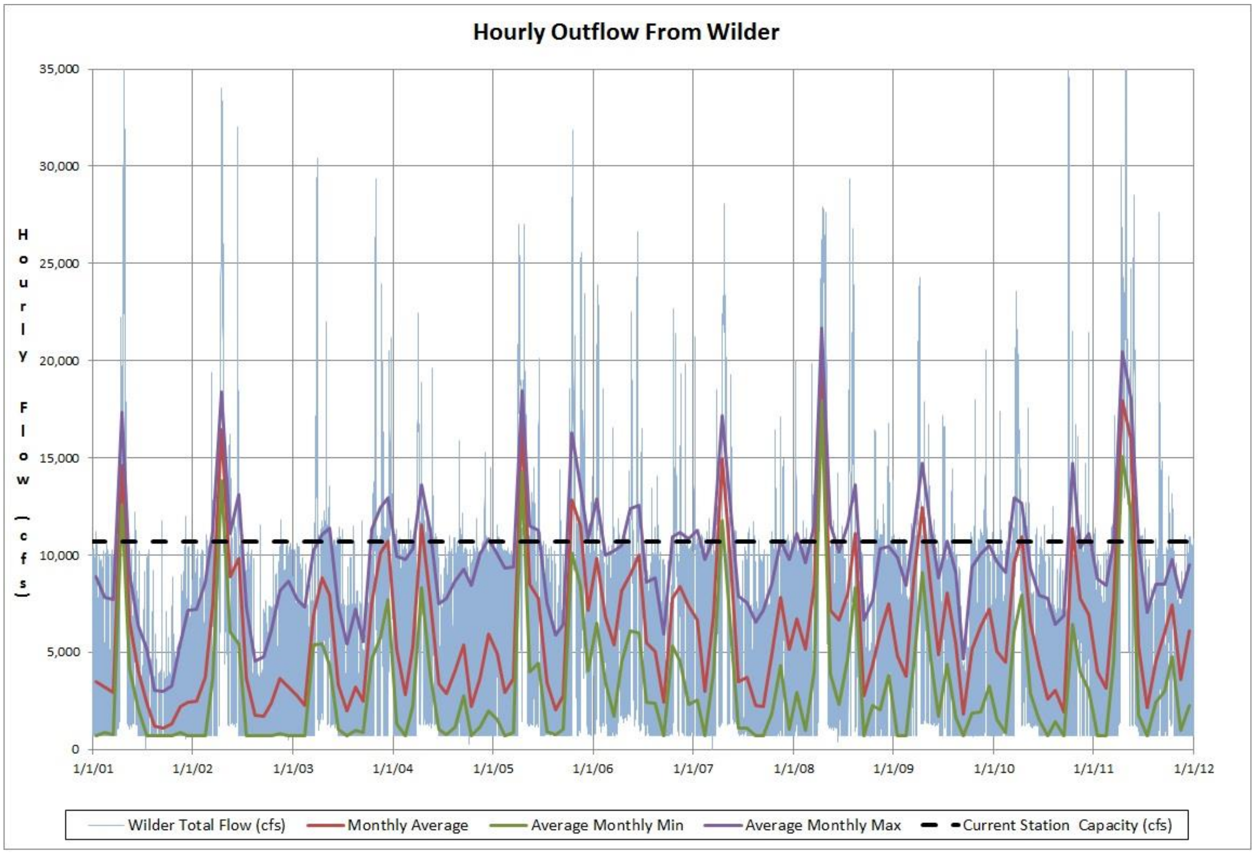

Figure 3.5-6. Hourly outflow from the Project.

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 Wilder to release a continuous minimum flow of 675 cfs or inflow if less.

There is limited use of surface water from the Wilder reservoir for consumption, irrigation, municipal water supply or industrial uses, and 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. There is only one surface water withdrawal from Wilder reservoir on record, and that is associated with the Hanover Country Club. USACE has a groundwater well for its Cold Regions Research and Engineering Lab in Hanover for industrial purposes 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, but any surface water withdrawals are likely to be very small in volume.

3.5.4 Water Rights

Currently there are no major water withdrawals from the Connecticut River within the Project area. However, as noted in section 3.5.3, there is a surface water withdrawal associated with the Hanover Country Club and a groundwater well in Hanover, New Hampshire. TransCanada is not aware of any other water rights within the Project 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 or [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 (Vermont DEC, 2011a). The current standards became effective December 30, 2011. 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 certain designated uses listed 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 Water Quality Standards, 2011[a]).

Class	Designated Uses	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 cold water 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 phosphorous 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% saturation, nor less than 95% 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	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 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 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.

3.5.6 Existing Water Quality

The Connecticut River within the Project area falls within Class B standards for both Vermont and New Hampshire, and displays water quality characteristics typical to a large New England River. With the exception of the few impairments to brooks and Wilder Lake, 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 CRJC's request, New Hampshire DES, assisted by 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 Management Plan (CRJC, 2008). 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. Table 3.5-4 summarizes data that are relevant to the Project area. All sites sampled within the Project area 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).

Table 3.5-4. New Hampshire DES Connecticut River Water Quality Assessment Project 2004.

Location (Collection Site Designation)	**DO (mg/L) low/high**	**DO (%Sat.) low/high**	**pH low/high**	**Temp (°C) low/high**	**Bacteria GeoMean (# /100ml)**
Wilder Impoundment (West Wheelock Street Bridge, Hanover, NH) NHLAK801040402-03	7.75 / 8.19	82.7 / 93.8	6.76 / 7.65	19.6 / 22.0	17.3
Route 25A Bridge, Orford, NH NHRIV801040205-06	7.29 / 8.54	84.2 / 91.5	6.62 / 7.62	19.1 / 23.0	43
Newbury Road Bridge, Haverhill, NH NHRIV801030703-04	7.50 / 8.59	84.9 / 93.5	6.86 / 7.61	18.5 / 22.0	53

The USGS National Water Information System has made available real-time, current and historic surface water quality records from its Connecticut River streamflow gage located immediately upstream of the Project area at Ryegate, Vermont, just above the confluence with Wells River. These data are displayed in table 3.5-5. 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, most likely as a result of upriver wastewater discharges. Relatively high concentrations of both nitrogen and phosphorus measured in March and April 2007 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.

Table 3.5-5. Water quality data in the vicinity of the Project, provided by the USGS National Water Information System for USGS 01138500, Connecticut River just above the confluence with Wells River, Ryegate, Vermont (Source: USGS,2012).

Date	Temp ^{O}C	Sp Cond uS/cm	DO mg/L	pH	Total N (unfiltered) mg/L	Phosphorus (unfiltered) mg/L
1-04-05	1.8	86	13.2	7.0	0.39	0.009
2-01-05	0.1	92	13.7	6.8	0.47	0.036
3-31-05	2.3	119	15.2	6.9	0.66	0.109
4-18-05	5.7	85	11.5	7.4	0.46	0.032
5-04-05	6.5	58	12.2	6.9	0.34	0.022
6-14-05	16.8	71	9.1	6.6	0.35	0.013
7-26-05	23	112	8.4	7.5	0.35	0.010
8-08-05	23.2	84	7.7	7.2	0.39	0.007
10-25-06	10.3	73	9.6	7.0	0.44	0.015
12-14-06	3.6	76	11.9	6.8	0.39	0.010
2-07-07	NA		NA	6.6	NA	NA
3-28-07	NA	79	NA	7.0	0.62	0.038
4-19-07	NA	70	NA	7.0	0.59	0.051
5-16-07	11.0	57	10.7	6.6	0.43	0.012
6-27-07	19.4	102	7.4	7.4	0.36	0.013
8-01-07	22.2	107	7.4	7.4	0.39	0.006
9-05-07	28.8	100	NA	7.4	0.35	0.006

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 Wilder Project from June 20 through September 11, 2012. Monitoring stations were located in New Hampshire waters (figure 3.5-7). Temperature, specific conductivity, pH, and DO were continuously monitored with a YSI model 6920 multiparameter sonde below Wilder dam in the tailrace area for the entire study period at Station W-TR. From week 4 through the end of the study, an additional continuous monitor was installed above the dam at Station W-01 at a depth within the upper 25 percent of the impoundment (about 8 feet deep) that also recorded temperature, specific conductivity, pH, and DO.

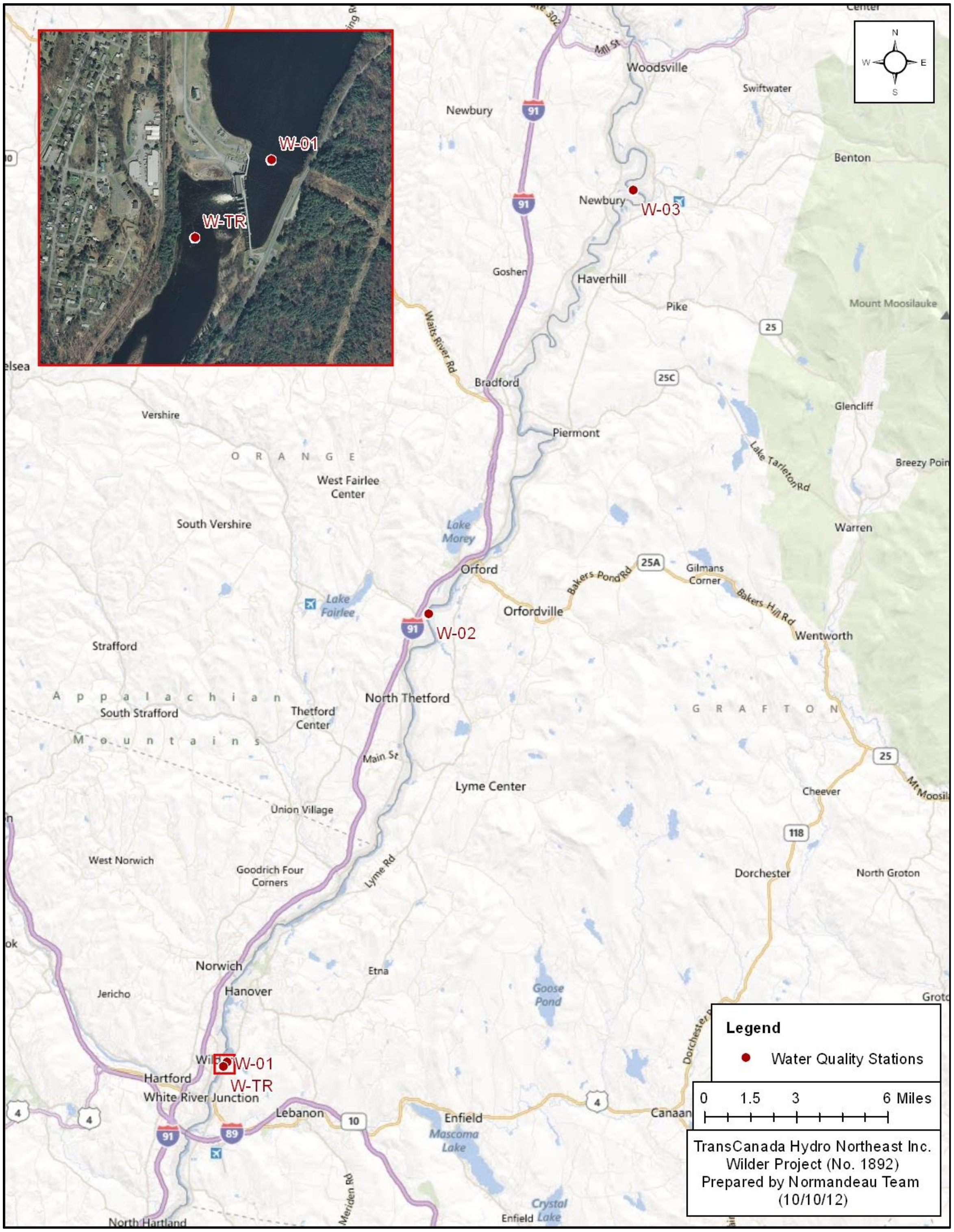

Figure 3.5-7. Map of study area showing monitoring stations. Inset map shows vicinity of Wilder dam.

Beginning at week 4 and continuing through the end of the study, weekly water samples were collected from Station W-01 and analyzed for nitrate/nitrite; total nitrogen; total phosphorous; total kjeldahl nitrogen; and chlorophyll-a. The water samples were extracted as a 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 Wilder impoundment at Stations W-01, W-02, and W-03 for the entire study period.

Tables 3.5-6 through 3.5-10 show statistical summaries of the field measurements taken for this project, 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 NH state standards DO saturation. Table 3.5-11 presents a summary of all laboratory analyses.

Table 3.5-6. Summary of temperature data.

Temperature (°C)	W-03 (Weekly Profiles)	W-02 (Weekly Profiles	W-01 (Weekly Profiles)	W-01 (Continuous Monitoring)	W-TR (Continuous Monitoring)
Max	22.57	25.14	25.98	26.47	25.42
Min	17.28	19.76	19.82	21.12	19.17
Median	20.86	21.83	22.83	24.08	23.59
Mean	20.34	21.94	22.66	23.96	23.24

Table 3.5-7. Summary of specific conductivity data.

Specific Conductivity (µS/cm)	W-03 (Weekly Profiles)	W-02 (Weekly Profiles	W-01 (Weekly Profiles)	W-01 (Continuous Monitoring)	W-TR (Continuous Monitoring)
Max	106	141	137	132	134
Min	88	81	85	88	80
Median	93	95	103	109	109
Mean	94	100	108	110	109

Table 3.5-8. Summary of pH data.

pH	W-03 (Weekly Profiles)	W-02 (Weekly Profiles	W-01 (Weekly Profiles)	W-01 (Continuous Monitoring)	W-TR (Continuous Monitoring)
Max	7.74	7.57	7.53	7.83	7.70
Min	5.72	6.37	6.64	6.95	7.07
Median	7.01	7.22	7.19	7.20	7.25
Mean	6.86	7.16	7.13	7.21	7.26

Table 3.5-9. Summary of DO data.

Dissolved Oxygen (mg/L)	W-03 (Weekly Profiles)	W-02 (Weekly Profiles	W-01 (Weekly Profiles)	W-01 (Continuous Monitoring)	W-TR (Continuous Monitoring)
Max	9.06	8.84	9.01	9.72	9.27
Min	7.88	7.42	6.04	5.66	6.52
Median	8.67	7.94	7.79	7.59	7.31
Mean	8.52	8.05	7.74	7.64	7.51

Table 3.5-10. Summary of oxygen saturation data.

Oxygen Saturation (% Saturation)	W-03 (Weekly Profiles)	W-02 (Weekly Profiles	W-01 (Weekly Profiles)	W-01 (Continuous Monitoring)	W-TR (Continuous Monitoring)
Max	102.7	102.4	107.6	118.7	109.6
Min	88.9	85.4	70.6	69.3	75.9
Median	93.6	91.0	88.6	90.9	87.4
Mean	94.3	92.0	89.6	91.9	89.0
Minimum 24 hour average	NA	NA	NA	77.6	78.5

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

Date	NO3/NO2 (mg/L)	TN (mg/L)	TP (mg/L)	Chlorophyll-a (mg/m^3)	TKN (mg/L)
7/10/2012	0.16	0.76	0.032	4.3	0.60
7/17/2012	0.17	0.54	0.018	5.1	0.37
7/24/2012	0.21	0.68	0.039	5.8	0.47
7/31/2012	0.22	0.60	0.015	3.1	0.38
8/7/2012	0.22	0.72	0.009	2.7	0.50
8/14/2012	0.18	0.55	0.016	4.2	0.37
8/22/2012	0.18	0.62	0.012	2.2	0.44
8/28/2012	0.19	0.59	0.019	3.3	0.40
9/4/2012	0.20	0.59	0.021	2.4	0.39
9/11/2012	0.17	0.64	0.010	1.6	0.47
Mean	0.19	0.63	0.019	3.5	0.44

Impoundment Data

DO/oxygen saturation generally declined slightly from upstream to downstream at the three stations in the impoundment, while temperature, specific conductivity and pH increased slightly from upstream to downstream. 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

DO/oxygen saturation decreased slightly, on average, between Stations W-01 and W-CM, above and below the dam, respectively. Temperatures were slightly lower at the station below the dam than the station above the dam. pH increased slightly from above the dam to below the dam while conductivity values were essentially the same between the two stations. Generally minor changes in upstream to downstream values of study parameters may 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 (approximately10 feet) 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 met state standards for Vermont and New Hampshire, with a few exceptions. The minimum pH data in table 3.5-8 for Stations W-03 of 5.72, and W-02 of 6.37, recorded on 6/26/12, are slightly below the minimum value of 6.5 for both Vermont and New Hampshire. pH values also dropped below 6.5 at Station W-03 on 7/10/12 and 8/16/12. These minimum values were recorded on a single day for each observation, and data from the surrounding days are above the state standard. These samples are located in the upper-most reaches of the impoundment and likely reflect episodic occurrences of lower pH associated with acidic atmospheric deposition. Wilder "Lake" is listed by New Hampshire DES as non-attainment for pH in the 2010 and 2012 303 (d) reports (section 3.5.6.3 below), so occasional low pH values were not unexpected.

As seen in table 3.5-9, the minimum dissolved oxygen level of 5.66 at the continuous monitoring station W-01, located just above the dam, fell below Vermont's standard of 6 mg/L. Concurrently, table 3.5-10 presents the minimum instantaneous value of oxygen saturation from same station, W-01, as 69.3 percent, which also fell below the oxygen saturation standard for Vermont (70 percent). However, the instantaneous values and the minimum daily average (tables 3.5-9 and 10) were never lower than the New Hampshire compliance standards of 5.0 mg/l and 75 percent saturation, respectively at any time during the study. These values reflect a decline in dissolved oxygen levels recorded during a seven-day period from 8/6/12 through 8/13/12 before rising again above the state standard by 8/16/12; this time period corresponded to a period of low flow, high temperature and elevated productivity as seen in the chlorophyll-a and total phosphorus values in table 3.5-11.

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, while New Hampshire only notes 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 does 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 total maximum daily loads (TMDL) 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 area 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.

New Hampshire DES previously considered the entire Connecticut River in New Hampshire contaminated by PCBs (CRJC, 2009a). 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, 2009a). 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.

Table 3.5-12 exhibits the New Hampshire DES 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 and designated use that is impaired, the type of impairment, the TMDL status and the source of impairment.

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

Unit ID/Location	Size	Designated Use	Impairment	TMDL Priority	TMDL Schedule	Source Name
2012						
Clark Brook, North Haverhill, NH, upriver of the Newbury-North Haverhill Bridge, mouth to upstream NHRIV801030703-02	22.33 miles	AL[a]	Aluminum, Fish Bioassessment, DO	Low	2019, 2021, 2023	Unknown
Grant Brook, Lyme, NH, south of Route 10 bridge, mouth to upstream NHRIV801040204-02	9.78 miles	AL	Fish Bioassessment	Low	2021	Unknown
Hewes Brook, Lyme, NH, downriver from confluence with Grant Brook, mouth to upstream NHRIV801040402-04	16.1 miles	AL, PCR[b]	Benthic Macroinvertebrate Bioassessment, Fish Bioassessment, E. coli	Low	2023, 2021, 2023	Unknown
Wilder Lake NHLAK801040402-03	1,760 acres	AL	pH	Low	2021	Atmospheric deposition-acidity
2010						
Clark Brook, North Haverhill, NH, upriver of the Newbury-North Haverhill Bridge, mouth to upstream NHRIV801030703-02	22.33 miles	AL[a], PCR[b]	Aluminum, Fish Bioassessment, E. coli	Low, Low, High	2019, 2021, 2010	Unknown
Grant Brook, Lyme, NH, south of Route 10 bridge NHRIV801040204-02	9.78 miles	AL	Fish Bioassessment	Low	2021	Unknown
Hewes Brook, Lyme, NH, downriver from confluence with Grant Brook, mouth to upstream NHRIV801040402-04	16.1	AL	Fish Bioassessment	Low	2021	Unknown
Wilder Lake NHLAK801040402-03	1,760 acres	AL, PCR	pH, E. coli	Low	2021, 2023	Atmospheric deposition-acidity, unknown

[a] Aquatic Life; [b] Primary Contact Recreation

The Vermont 303(d) 2010 and 2012 (draft) reports do not list any impaired sections of the main stem of the Connecticut River or tributaries adjacent to Project waters.

In the case of the Project waters listed above, the source of impairments is unknown in most cases. Clark Brook is a widespread brook draining the town of Haverhill lists impaired biota, and in 2012 added DO impairment with an unknown cause. Hewes Brook enters a steep hemlock ravine with ledges and cascades, with the old town dump of Lyme on its banks before reaching the river and public canoe launch area. This brook drains urbanized sections of Hanover and Lyme. Grant Brook has a heavily forested upper corridor but is a water source for snowmaking withdrawal for Dartmouth Skiway. Sediment from the skiway parking lot runs into this brook, and a local road closely follows for much of its length (CRJC, 2009).

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

General Advisory	Children and Women of Childbearing Age	Everyone Else
Largemouth Bass Northern Pike Yellow Perch (larger than 10 inches)	No more than 2 meals/month	No more than 6 meals/month
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-90s, and the Project has held a valid discharge permit ever since. NPDES # VT0000787, permit #3-1393 allows the Project to discharge minor, non-generation related wastewaters, including non-contact cooling water from Units No. 1, No. 2 and No. 3, internal facility drainage, and sump pit waters associated with Unit No. 3. The Project is required to undertake quarterly sampling of its wastewaters and report the results of the sampling to the permitting authority (Vermont Department of Environmental Conservation). 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); and
- Oil/grease (<20 mg/l, not required for non-contact cooling water).

All sources of wastewater combine into a single outfall. The daily maximum flow limitation for outfall S/N 001 is 2.3 million gallons per day.

TransCanada has never measured a permit exceedence at the Wilder Project.

There are 18 wastewater treatment facilities within the Connecticut River watershed above the Wilder Project that discharge into the Connecticut River main stem or its tributaries. Table 3.5-14 lists these facilities.

Table 3.5-14. Wastewater treatment facilities within the Connecticut River watershed above the Project.

Colebrook NH	Littleton NH
Stratford Village NH	Lisbon NH
Stratford Mill House NH	Woodsville NH
Groveton NH	Lunenburg VT
Northumberland NH	Lyndon VT
Lancaster NH	Ryegate VT
Lancaster Grange NH	St. Johnsbury VT
Whitefield NH	Bradford VT
Bethlehem NH	Hanover NH

3.5.7 Project Effects on Seasonal Variation of Water Quality

Wilder 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 suggest 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

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3.6 FISH AND AQUATIC RESOURCES

3.6.1 Introduction/Fisheries Overview

This section reviews existing information for the fish and aquatic resources within the Wilder Project affected area, defined for the purposes of this section as the Wilder impoundment to 46 miles upstream of the Project, the riverine segment about 17 miles downstream to the Bellow Falls impoundment at about river mile 195, and including 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). In the Wilder Project area, coldwater species, trout and salmon (*Salmo salar*), reside or migrate seasonally, and cool and warmwater species, such as walleye (*Sander vitreus*), bass (*Micropterus spp.*), and perch (*Perca flavescens*), reside year round. In the 46-mile impoundment, the river functions more like a lentic system. Fish species assemblage includes more warmwater species. Downstream of Wilder dam, the river is lotic, though river flow varies due to Project operations (CRJC, 2009).

Recreational fishing occurs in the waters immediately upstream and downstream of Wilder dam. Fishing upstream of the dam focuses primarily on bass and northern pike (*Esox* lucius) whereas targeted effort for rainbow trout, brown trout, and smallmouth bass occurs in the tailwater (Hanover Outdoors, www.hanoveroutdoors.com). In addition, the Connecticut River supports an excellent spring and fall fishery for walleye at Wilder dam (Dartmouth Outing Club, www.dartmouth.edu/~doc).

The New Hampshire Fish & Game Department (New Hampshire Fish & Game) compiled lists of suggested fishing locations, though not site specific, that identified the Connecticut River in southwest New Hampshire as fishing locations for black crappie, bluegill, brown bullhead, common carp, chain pickerel, fallfish, largemouth bass, northern pike, rock bass, smallmouth bass, walleye, white perch, and yellow perch. Additionally biologists in the upper Connecticut River (Great North Woods) identified the Connecticut River from Woodsville, New Hampshire, south as suggested fishing location for American eel (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 fontanalis*) and rainbow trout (*Oncorhynchus mykiss*) into waters of the state including the primary Project tributaries: White River, Ompompanoosuc River, Wells River, and Waits River (Vermont Fish & Wildlife, 2009, 2010b). New Hampshire Fish & Game stocks brook trout, rainbow trout, and brown trout (*S. trutta*) to many tributaries to the Connecticut River including the Ammonoosuc 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 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, 2012). 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

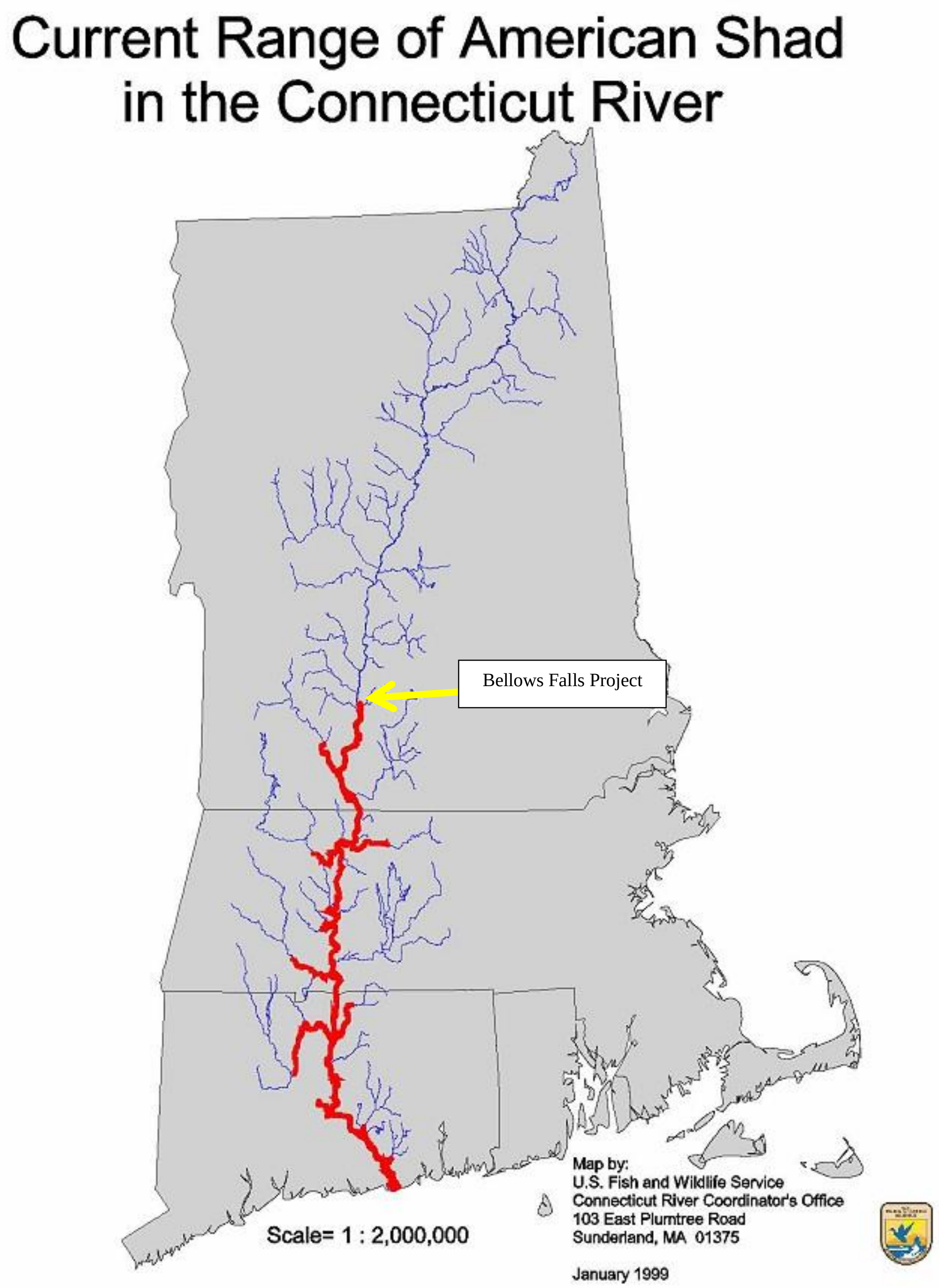
The historic upstream extent of the range of American shad (*A. sapidissima*) and blueback herring (*A. aestivalis*) in the Connecticut River is understood to be Bellows Falls, downstream of the Wilder Project (Deen, 2009; Gephard and McMenemy, 2004; Castro-Santos and Letcher, 2010; figure 3.6-1). American shad, blueback herring, and sea lamprey (*Petromyson marinus*) passed or transported upstream of the further downstream Vernon dam potentially continue to migrate upstream to Bellows Falls and occasionally small numbers of American shad have passed upstream of Bellows Falls (Kart et al., 2005; FWS, 2012; table 3.6-1). American shad that pass upstream of Bellows Falls dam may be able to use spawning and rearing habitat in the Project affected area downstream of Wilder dam, though access to that habitat may be categorized as 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 the Wilder Project area. In certain years hundreds to thousands of sea lamprey have been recorded passing upstream of Bellow Falls dam, and in at least one year (2008) sea lamprey were documented passing upstream via the Wilder dam fish ladder (table 3.6-1). In 2008 surveys, Yoder et al. (2009) documented sea lamprey just downstream of the confluence of the White River. Studies of Atlantic salmon passage pertinent to the Project area are discussed in section 3.6.2.

Resident species have also been recorded using the Wilder fish ladder. Those data are currently being managed by Vermont Fish & Wildlife personnel, and 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 Fishery Studies

No targeted studies have been conducted to characterize the fish community in relation to the Project. However, studies of greater scope and studies based on specific management goals and considerations include important information pertinent to the Project. Note that species assemblage data are limited and species abundance data are lacking so information synthesized in this section should not be considered a full representation of species occurrence in the Project area.



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, Bellows Falls, and Wilder dam fish ladders (Source: Vermont Fish & Wildlife, 2010a; Normandeau, 2011b; CRASC, http://www.fws.gov/r5crc/Fish/hist.html).

Year	Vernon				Bellows Falls			Wilder		
	American Shad	Atlantic Salmon	Sea Lamprey	Blueback Herring	American Shad	Atlantic Salmon	Sea Lamprey	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	0	3	0
1988	1,370	5	281	0	24	3	0	0	2	0
1989	2,953	0	205	49	*	*	*	*	*	*
1990	10,894	9	387	54	0	5	47	0	1	0
1991	37,197	6	750	383	65	3	34	0	1	0
1992	31,155	13	749	27	103	4	89	0	0	0
1993	3,652	7	627	28	2	0	17	*	*	*
1994	2,681	8	767	10	3	3	34	0	1	0
1995	15,771	5	509	115	147	1	44	*	*	*
1996	18,844	9	853	11	1	3	180	0	0	0
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	**	1	**
2000	1,548	5	855	2	9	2	102	**	2	**
2001	1,744	1	3,212	0	**	1	**	**	**	**
2002	356	3	2,210	0	**	**	**	**	**	**
2003	268	0	8,119	0	*	*	*	*	*	*
2004	653	1	3,668	0	**	1	**	**	1	**
2005	167	4	3,669	0	3	3	229	**	2	**
2006	133	4	2,895	0	0	0	261	*	*	*

Year	Vernon				Bellows Falls			Wilder		
	American Shad	Atlantic Salmon	Sea Lamprey	Blueback Herring	American Shad	Atlantic Salmon	Sea Lamprey	American Shad	Atlantic Salmon	Sea Lamprey
2007	65	5	17,049	0	0	3	709	0	0	0
2008	271	8	22,434	0	0	8	2233	0	4	2
2009	16	7	1,532	0	0	4	100	0	1	0
2010	290	8	3,179	0	0	4	392	0	2	0
2011	46	9	329	0	1	6	74	0	3	0
2012	10,715	4	696	0	0	2	99	0	2	0

[a] Based upon average or targeted release to upstream of Holyoke Dam (river mile 86) of 10% of returns.

* Fish ladder was not operated.

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

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, 1992a; b; 1993; 1994a; b; 1995).

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 Wilder impoundment (from 49 to 1.6 miles upstream) and five stations occurred in the Project affected area below Wilder dam (from 0.1 to 15.5 miles downstream). Overall, 26 species were recorded in the Project area. Twenty species were recorded in the impoundment upstream of the dam, and twenty species were recorded in the river downstream of the dam, however, species assemblage differed somewhat between the two reaches of the Project area (see table 3.6-2).

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

Species	**Upstream**	**Downstream**
American eel (*Anguilla rostrata*)		
Atlantic salmon (*Salmo salar*)	2	1
Banded killifish (*Fundulus diaphanus*)	1	1
Black crappie (*Pomoxis nigromaculatus*)	1	1
Blacknose dace (*Rhinichthys atratulus*)		1
Bluegill (*Lepomis macrochirus*)	1	
Bridle shiner (*Notropis bifrenatus*)	1	
Brown bullhead (*Ameirus nebulosus*)	1	
Brown trout (*Salmo trutta*)		4
Chain pickerel (*Esox niger*)	1	1
Common shiner (*Luxilis cornutus*)	1	1
Creek chub (*Semotilus atromaculatus*)		1
Fallfish (*Semotilus corporalis*)	1	1
Largemouth bass (*Micropterus salmoides*)	1	1
Longnose dace (*Rhinichthys cataractae*)	1	
Mimic shiner (*Notropis volucellus*)	1	

[2] Project affected area defined here as extending approximately 46 miles upstream and 17 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: Normandeau (2011b); 3: New Hampshire Fish & Game (unpublished data, Sprankle, 1997); 4: Anecdotal information, Hanover Outdoors (Hanoveroutdoors.com); 5: Anecdotal information, Dartmouth Outing Club (http://www.dartmouth.edu/~doc/fishing/lebanon).

Species	Upstream	Downstream
Northern pike (Esox *lucius*)	1	1
Pumpkinseed sunfish (*Lepomis gibbosus*)	1	1
Rainbow trout (*Oncorhynchus mykiss*)		1, 4
Rock bass (*Ambloplites rupestris*)	1	1
Sea lamprey (*Petromyzon marinus*)		1
Smallmouth bass (*Micropterus dolomieui*)	1	1
Spottail shiner (*Notropis hudsonius*)	1	
Tessellated darter (*Etheostoma olmstedi*)	1	1
Walleye (*Sander vitreus*)		1, 3, 4
White sucker (*Catostomus commersonii*)	1	1
Yellow perch (*Perca flavescens*)	1	1

Yoder et al. (2009) made an initial assessment of the upper Connecticut River mainstem fish assemblages was done 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. Both IBIs and the MIwb showed a general decline from the upstream-most sites downstream to just above Wilder dam (figure 3.6-2 below, consisting of 3 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 in the Wilder Project area, transitioning from the high gradient upper river to a lower gradient, contributing naturally to that trend.

A.

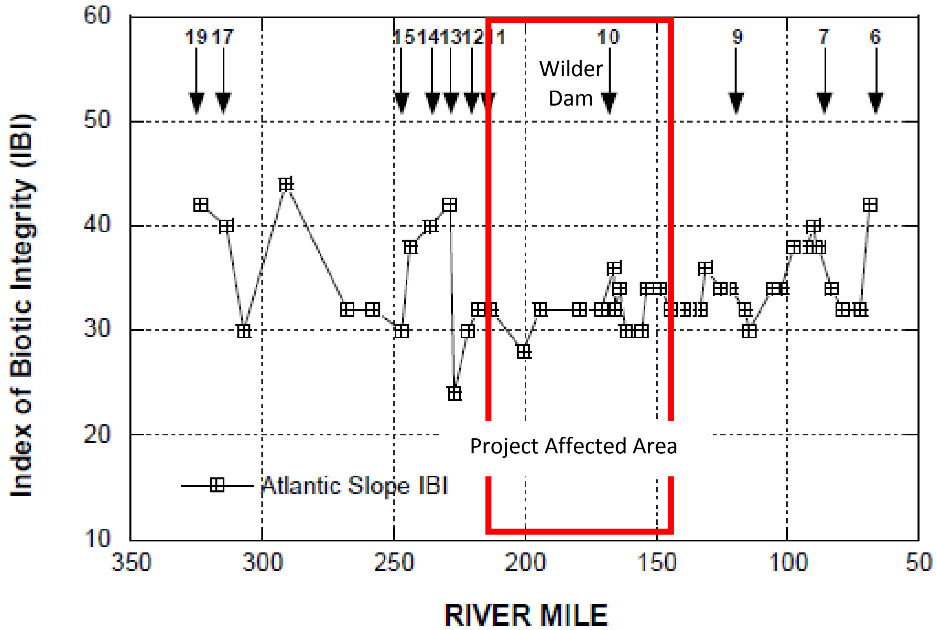


Figure 6. Atlantic slope Index of Biotic Integrity (IBI; Daniels et al. 2005) results in the upper Connecticut R. between Lake Francis and Turners Falls, 2008.

B.

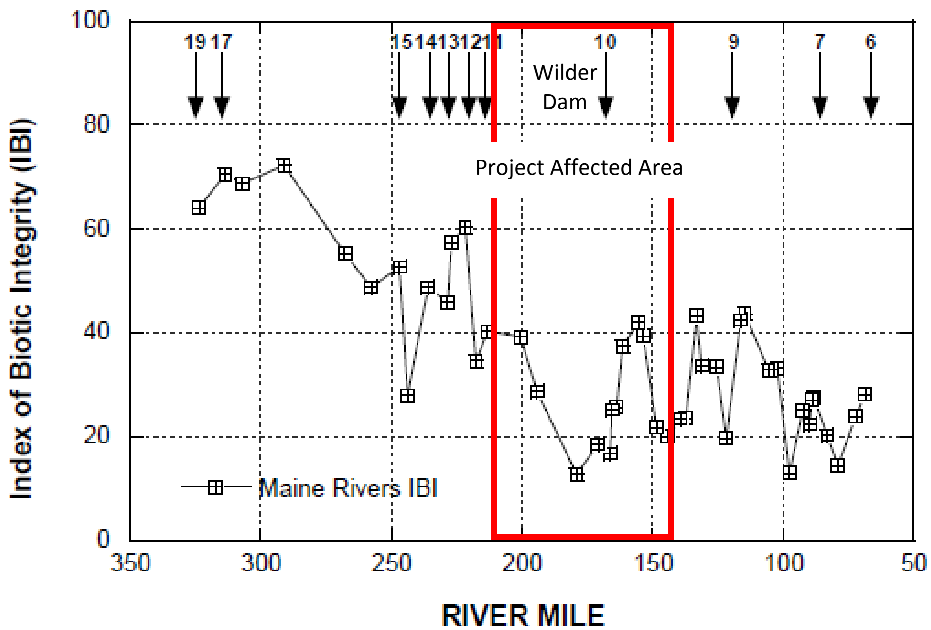


Figure 7. Interim Maine Rivers Index of Biotic Integrity (IBI; Yoder et al. 2008) results in the upper Connecticut R. between Lake Francis and Turners Falls, 2008.

C.

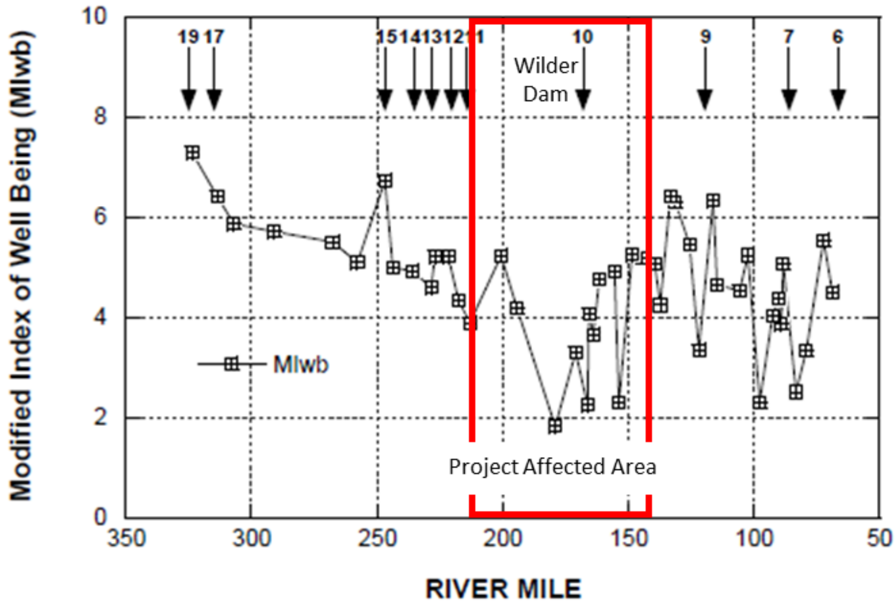


Figure 8. Modified Index of Well-Being (MIwb) results in the upper Connecticut R. between Lake Francis and Turners Falls, 2008.

Source (Yoder et al. 2009)

Figure 3.6-2. Results of Yoder et al. (2009) for the Connecticut River from Lake Francis to Turners Falls. A. Atlantic slope Index of Biotic Integrity; B. Interim Maine Rivers Index of Biotic Integrity; C. Modified Index of Well-Being. Arrows labeled '10' indicate location of Wilder dam. Red box indicates stations within the Project affected area.[3]

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). The Vermont angling record walleye for the Connecticut River was for a 12.5 lb fish taken from below Wilder dam in 1981 (http://www.vtfishandwildlife.com/Fishing_frmRecords.cfm).

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 and a 1995 and 1996 survey included the Wilder tailrace (Sprankle, 1997).

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[3] River miles were measured from the head of tide rather than from river mouth in Yoder et al. (2009) so distances (river miles) differ than from those stated in other parts of this PAD.

The purpose of Carrier and Gries' (2010) study was to compare new data with those collected in 1995-1996 to determine if fishery management objectives intended by 1998 regulations (a daily limit of 4 fish; no fish between 406 mm and 457 mm and only 1 fish larger than 457 mm can be harvested) were being met. They concluded that all measurable objectives (at the time of reporting) were met and that the majority (93 percent) of anglers interviewed were supportive of the current walleye regulations on the Connecticut River. In the earlier study, 85 percent of length samples were collected from Wilder Dam and in the 2009 collections only 6 percent were from Wilder. Carrier and Gries (2010) found that mean lengths (including data from Wilder, Vernon, and Bellow Falls dam fisheries) were significantly greater in the later studies, but there was no significant difference in mean total length among sites.

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. The study objectives were 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. Study Reach 5 extended from above Vernon dam to Wilder dam. Reach 6 extended from above Wilder dam to Moore dam.

Three species of fish, smallmouth bass (*M. dolomieui*), 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. Total mercury concentrations for samples from Reach 6, which included but extended beyond the Project affected area upstream of Wilder Dam, was generally higher than all reaches downstream of it in yellow perch and white suckers but in smallmouth bass was similar to reaches further downstream. Total mercury concentration from samples collected in Reach 5 was similar to more downstream reaches for all three species. Hellyer (2006) hypothesized that, while mercury is mostly deposited in the Connecticut River watershed from the atmosphere, higher levels of mercury in the upper reaches may have been partially due to water level manipulations, particularly in reservoirs.

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, for smallmouth bass, white sucker and yellow perch among the seven study reaches of the Connecticut River. Smallmouth bass condition factor was significantly higher in Reach 5 as compared to all other reaches (figure 3.6-4). Yellow perch condition factor was significantly higher in Reaches 5 and 6 compared to all other reaches (figure 3.6-5). No significant difference in white sucker condition factor was detected among reaches (figure 3.6-6; Hellyer, 2006).

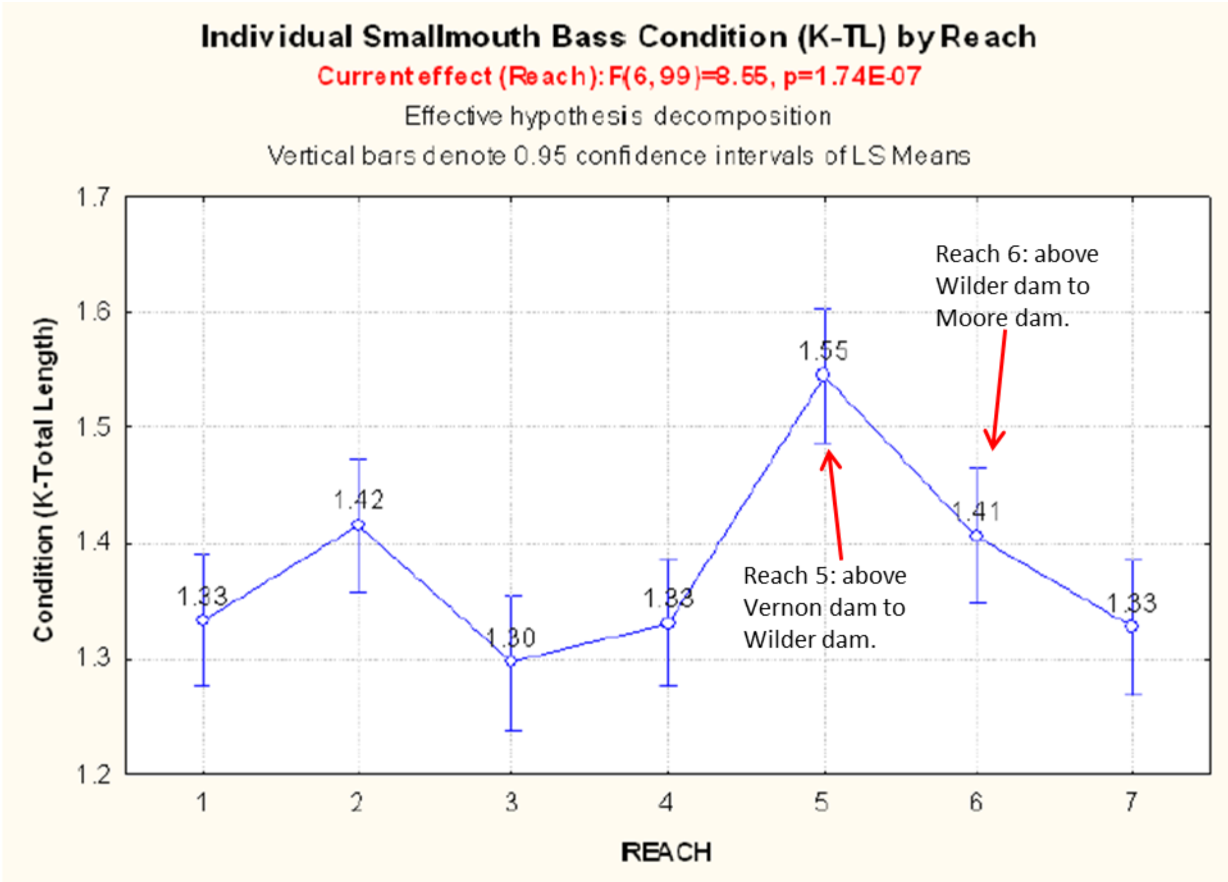

Figure 143. ANOVA of Individual Smallmouth Bass Condition (K-TL) by Reach

Source (Hellyer, 2006)

Figure 3.6-3. Results of Analysis of Variance of individual smallmouth bass condition by Connecticut River reach. Reach 5 = above Vernon dam to Wilder dam; Reach 6 = above Wilder dam to Moore dam (Source: Hellyer, 2006).

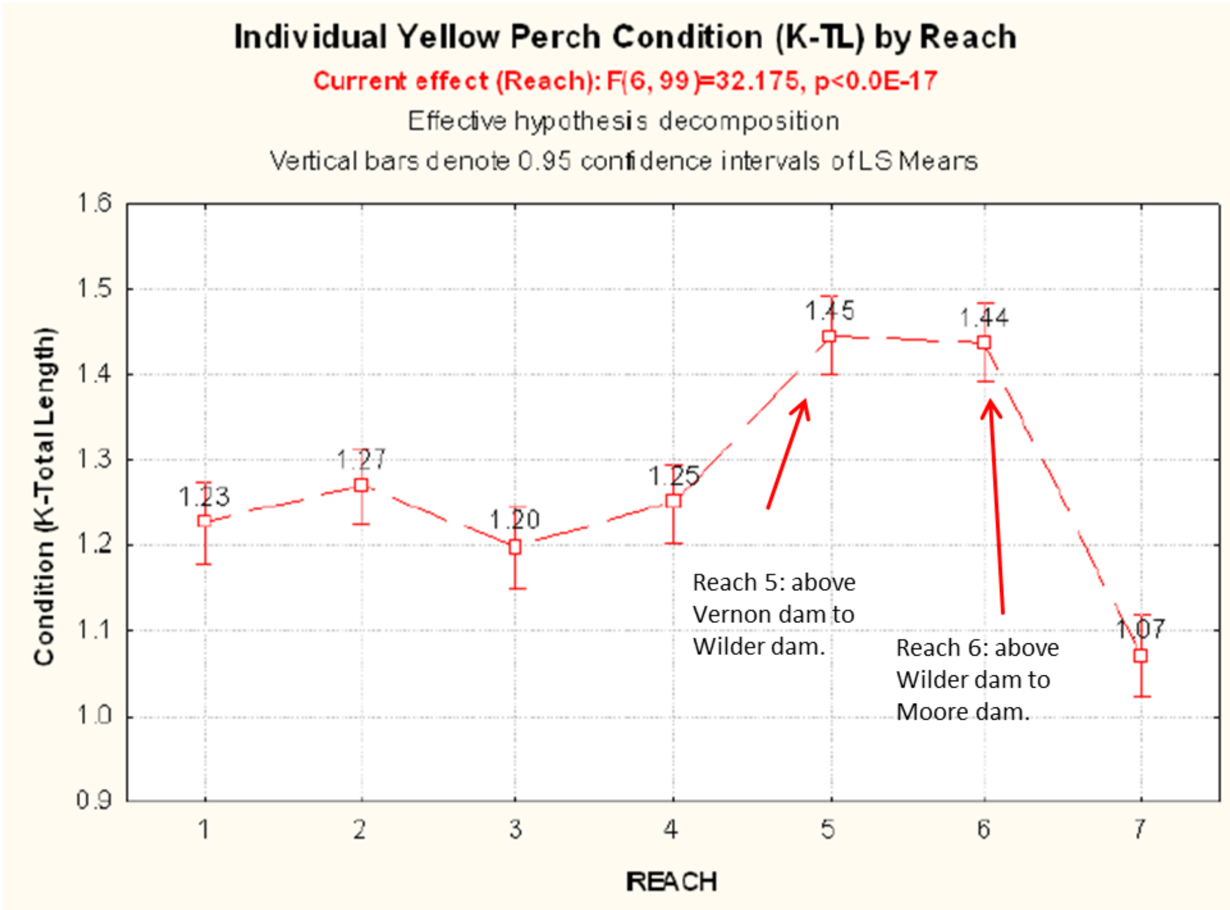

Figure 150. ANOVA of Individual Yellow Perch Condition (K-TL) by Reach

Source (Hellyer, 2006)

Figure 3.6-4. Results of Analysis of Variance of individual yellow perch condition by Connecticut River reach. Reach 5 = above Vernon dam to Wilder dam; Reach 6 = above Wilder dam to Moore dam (Source: Hellyer, 2006).

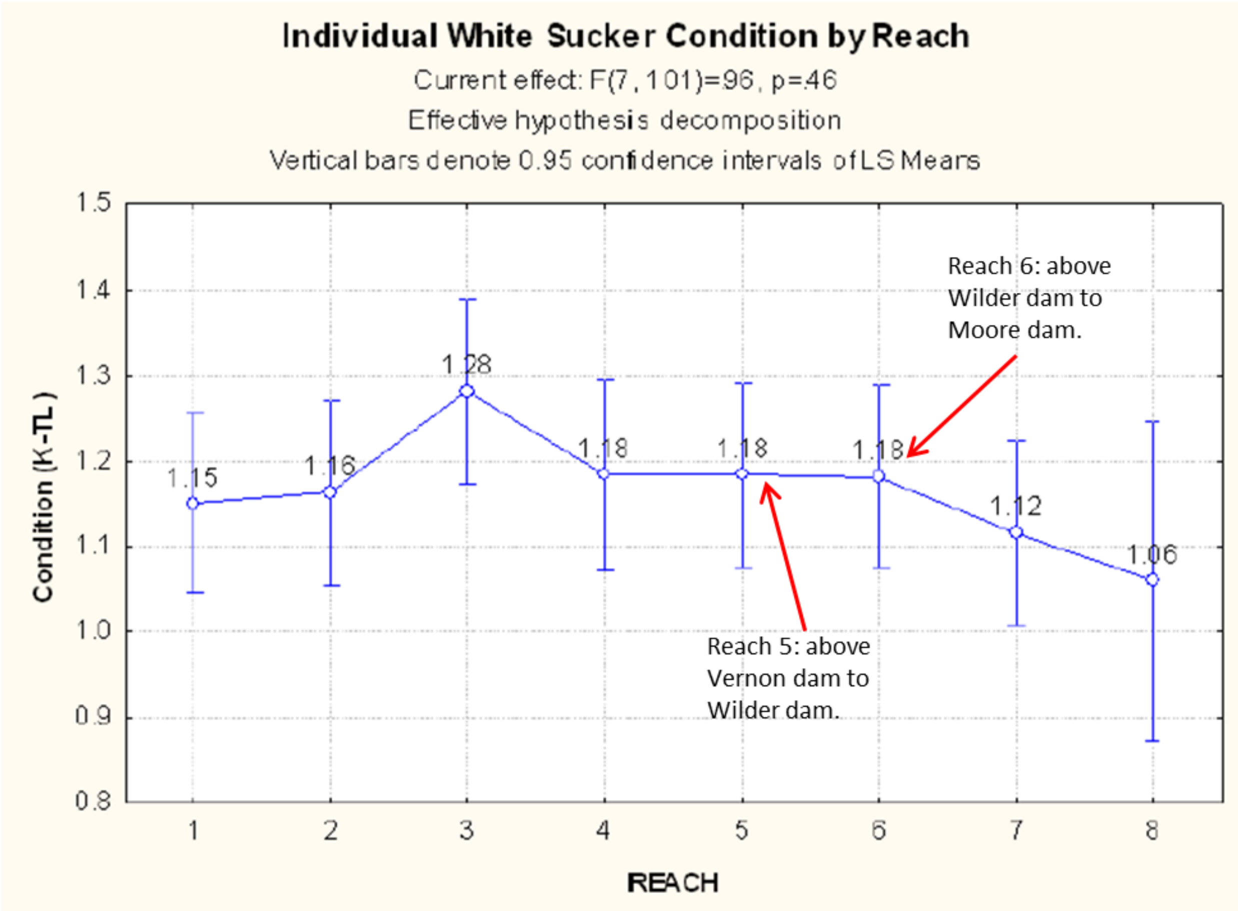

Figure 155. ANOVA of Individual White Sucker Condition by Reach

Source (Hellyer, 2006)

Figure 3.6-5. Results of Analysis of Variance of individual white sucker condition by Connecticut River reach. Reach 5 = above Vernon dam to Wilder dam; Reach 6 = above Wilder dam to Moore 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 has been placed on fish passage at barrier dams. Early fishways were justified on the basis of existing American shad runs, and later upriver fishways, including Wilder dam's fish ladder, were built to support future salmon runs (Gephard and McMenemy, 2004). The Vermont Department of Fish & Wildlife (Vermont Fish & Wildlife) and Normandeau Associates have monitored adult Atlantic salmon utilization of the Wilder fish ladder since 1998 (see table 3.6-1). The first radio tagged adult salmon to pass was in 1999 (Normandeau, 2011b). Typically, few fish are radio-tagged (typically 10 fish/year) because the majority are captured at Holyoke dam for 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 license. Such efforts have proven valuable for the entire Connecticut River Basin and so have continued annually. Overall, 44 percent of all salmon that passed the Bellows Falls Project also passed the Wilder Project (see table 3.6-1).

Behavior and movement studies of Atlantic salmon smolts at the Wilder Project were initiated in 1991 to determine if the existing log/ice sluice would provide an effective downstream passage route for emigrating smolts. Results indicated most (at least 91 percent) tagged smolts passed via the log/ice sluice (RMC, 1992b). A survival test was conducted the following year to determine if the route provided safe passage, and the survival rate was determined to be near 97 percent (RMC, 1992a). Additional radio-telemetry studies were conducted in 1993 and 1994 to determine if stream reared smolts behaved differently than hatchery reared smolts, and to see if the log/ice sluice gate setting could be used to enhance passage effectiveness. Gross behavioral differences between hatchery and stream reared smolts were not detected (RMC, 1993), demonstrating that hatchery reared smolts were an acceptable surrogate for stream reared (wild) smolts. The majority of radio tagged smolts more readily used a 5-foot open gate over a 2.5- or 3.5-foot gate setting, resulting in a recommendation to operate that gate at the greater open setting to facilitate passage (RMC, 1995). In 1994, a turbine passage survival study was conducted to determine if the Project's Kaplan turbines were detrimental to smolts passing through them. Long-term survival of turbine passed smolts was estimated to be 94 percent (RMC, 1994a, 1994b).

The Nature Conservancy Northeast Aquatic Connectivity Project

Fragmentation by dams can result in loss of access to quality habitat for one or more life stages of a species (Martin and Apse, 2011). The Northeastern United States (the New England and Mid-Atlantic states) has the highest density of dams and road crossings in the country, with an average of seven dams per 100 miles of river (Anderson and Olivero Sheldon, 2011). 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 (SGCN). The project was initiated to support resource agencies in their 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 Geographical Information System (GIS) 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. 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 don't meet specific criteria, and modify the metric weights to develop new scenarios. The Barrier Analysis Tool is an ArcGIS 9.3 plugin 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 km over 9,140 km 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

Fish species of greatest conservation need were identified in Vermont's Wildlife Action Plan (WAP) (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 WAP were either documented, known to use, expected to use, or have potential to be restored to use of habitats within the Wilder Project area. Diadromous species listed as species of greatest conservation need included sea lamprey, American eel (*Anguilla rostrata*, Vermont Species of Concern), and Atlantic salmon. Resident species included bridle shiner (New Hampshire listed as threatened, Vermont Species of Concern), brook trout, and redbreast sunfish (*Lepomis auritus*, table 3.6-4).

New Hampshire Wildlife Action Plan

New Hampshire 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 3.6-4). 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 are listed as threatened by the state of New Hampshire.

Table 3.6-4. Fish species listed in state conservation plans as species of greatest conservation need that occur in the Project area.

	State Conservation Plan Priority	
Species	**New Hampshire**	**Vermont**
American eel (*Anguilla rostrata*)	S5	S2, SC
Atlantic salmon (*Salmo salar*)	S4	S4
Bridle shiner (*Notropis bifrenatus*)	S3, T	S1?, SC
Brook trout (*Salvelinus fontinalis*)	S5	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

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

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).

3.6.4 Diadromous Species Descriptions

The life histories and distribution of diadromous fish species that are known or suspected 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 un-pigmented 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 about 8 to 10 inches (20 to 25 cm) 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. Outmigrating 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.

Within the Connecticut River Basin, American eel have been documented upstream of Bellow Falls Dam (Yoder et al., 2009). Although passage into the Wilder Project area is available (based on their presence upstream of Bellows Falls) American eels were not documented in the Wilder Project area during the most recent survey (Yoder et al., 2009).

Atlantic Salmon

Atlantic salmon is a highly migratory, anadromous fish species which were indigenous to suitable riverine habitat from northeastern Labrador south to the Housatonic River located in Long Island Sound (Kocik and Friedland, 2002). Numerous reviews detailing the life history of Atlantic salmon exist (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 comprises fish having been at sea for one or three years as well as repeat spawners. Fecundity varies 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). 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 back downstream and into the ocean but the majority move back downstream and into 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 from the gravel 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 during that period. Following that period, each parr undergoes a series of physiological and morphological changes known as smoltification. During smoltification, the fish lose their parr markings and develop a streamlined, silvery body and a pronounced forked tail. It is at that time that these fish move downstream through the freshwater river system and into the ocean. This downstream migration takes place during the spring months (April-June). Outmigrating 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, 2012). 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.

Atlantic salmon smolts migrating downstream from tributaries upstream of the Project area must pass downstream of the Project. A single individual (weight = 50 g) was collected during the 2008 electrofishing survey which sampled approximately five river kilometers of habitat in the Project area downstream of the dam (Yoder et al., 2009). Between 2004 and 2011, 13,351 stream reared smolts collected at Moore dam have been released below McIndoes dam (Normandeau 2005 – 2011a). Hatchery reared smolts (n=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 the dams between Moore and Turners Falls (Comerford, McIndoes, Dodge Falls, Wilder, Bellows Falls, and Vernon). These 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 and Bellows Falls Dams before tracking was suspended some 20 to 30 days after the final smolt passage at McIndoes.

Adult Atlantic salmon have also been documented in the Project area. Since 1998, a percentage of sea-run returns to the Connecticut River have been radio-tagged at the Holyoke fishlift and had their movements within the river monitored. Of the 146 individuals radio-tagged (1998-2011), 7.5 percent have been documented passing through the Project area and passed Wilder dam (Normandeau, 2011). Four radio-tagged individuals have been recorded entering the Ammonoosuc River tributary during high flow events. Timing of arrival at the Wilder dam for radio-tagged adult Atlantic salmon during 2011 took place during mid to late-June. Individuals were documented using the Project area upstream of the dam during July, August, and September 2011.

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 Wilder Project affected area downstream of the dam, but not upstream (Yoder et al., 2009). A total of nine individuals were collected during the 2008 electrofishing survey which sampled approximately five river kilometers of habitat in the Project area downstream of the dam. Relative abundance for stations where lamprey were collected ranged from 2 to 4 fish/km and numeric proportional of the catch ranged from 1.6 to 11.1 percent. In certain years, hundreds to thousands of sea lamprey have been counted passing upstream at Bellows Falls dam, representing a population that may be available to access habitat in the Wilder Project affected area (see table 3.6-1).

3.6.5 Resident Species Descriptions

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

Bridle Shiner

Bridle shiner (*Notropis bifrenatus*) 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 State (Scott and Crossman, 1979). Bridle shiners 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 2-3 feet and areas surrounded by dense vegetation. Bridle shiner was listed as threatened by the state of New Hampshire in 2008.

Bridle shiners were documented in Wilder Project area downstream of the dam, but not upstream (Yoder et al., 2009). A total of four individuals were collected in one electrofishing sample in the Project area upstream of the dam. Relative abundance for that 1 km sampling was 4 fish / km, contributing 9.3 percent of the numeric total catch.

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 nineteenth 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^{o} 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 Wilder Project 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 which enter the Wilder Project area. Trout stocked in those tributaries may move to the mainstem river seeking suitable habitat and enhance the fisheries there as well.

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 1800s (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 main stem or smaller tributaries. Mature rainbow trout (2 to 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 rainbows 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 in length.

Rainbow trout were documented in the Project area downstream of the dam, but not upstream (Yoder et al., 2009), and are taken in the fishery below the dam. Two individuals (average weight of 925 g) were collected at one station during the 2008 electrofishing survey, which sampled approximately five river kilometers (5 stations) of habitat in the Project area downstream of the dam. Relative abundance at that station was 2 fish / km, contributing 11.1 percent of the numeric catch.

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, 1987). 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 Wilder Project area in the Connecticut River from Waits River to White River (Kart et al., 2005). Yoder et al. (2009) did not collect any redbreast sunfish in the Wilder Project area, though two specimens were collected downstream in the Bellows Falls Project area.

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 (*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. Although slimy sculpin were collected in samples upstream of the Wilder Project area, none were collected in the Project affected area (Yoder et al., 2009).

Smallmouth Bass

Smallmouth bass are non-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 United States (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 have been documented in the Project area both upstream and downstream of the dam (Yoder et al., 2009). Smallmouth bass were recorded in 5 of 7 1-km sample areas upstream of the dam with relative abundance at the stations where the species was collected ranging from 1 to 13 fish / km, contributing 6 to 35 percent of the samples numerically. Smallmouth bass were collected at all five stations sampled in the Project area downstream of the dam with relative abundance ranging from 11 to 128 fish / km, and contributing from 9 to 67 percent of the samples numerically.

Tessellated Darter

The tessellated darter resides 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 (*Alasmidonta heterodon*), 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).

Tessellated darters have been documented in the Project area both upstream and downstream of the dam (Yoder et al., 2009). Tessellated darters were recorded at four of the five one kilometer sample areas downstream of the dam. Abundance relative to total catch at the four electrofish sample areas where tessellated darters were present in the lower portion of the Project area ranged from 5.1 to 1.1 percent. Tessellated darters were collected in electrofish samples near the upper end of the Project area upstream of the dam. Abundance relative to total catch at the two electrofish sample areas where tessellated darters were present in the upper portion of the Project area was 6.6 and 10.0 percent.

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).

Walleye were documented in the Wilder Project area downstream of the dam, but not upstream (Yoder et al., 2009), and are frequently taken in the fishery below the dam. A total of two individuals were collected at one (of 5) 1-km sampling stations downstream of the dam during the 2008 electrofishing survey. Relative abundance for that station was 2 fish/km, contributing 7.7 percent of the numeric catch.

3.6.6 Aquatic Habitat

In conjunction with the assessment of the fish assemblage of the mainstem Connecticut River (Yoder et al., 2009), a qualitative evaluation of macrohabitat was made for each location sampled. 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 for the Project area suggested a reduced number of good quality attributes in the Project area compared to areas upstream (e.g., >46 miles upstream of Wilder dam); however, the characteristics were similar to those of most areas downstream of the Project area. Habitat attributes affecting the QHEI in the Project area were typical of impoundments, including reduced substrate diversity, siltation / substrate embeddedness, lack of current complexity, and lack of riffle / run characteristics (figure 3.6-6).

Table 1. QHEI attributes report for sites sampled in the Connecticut River during 2008.

Key
QHEI
Components

River Mile	QHEI	Gradient (ft/mile)	Good Attributes: 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	Modified 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																											
323.6	92.5	13.80	■	■	■	■	■	■	■	■	■	■	10														0	0.00
322.0	89.0	20.10	■	■	■	■	■	■	■	■	■	■	10														0	0.00
313.7	82.5	2.00	■	■	■	■	■	■	■	■	■	■	10														0	0.00
307.1	65.0	2.00	■	■			■	■	■		■		6								■			■		■	3	0.50
291.0	87.0	16.60	■	■		■	■	■	■	■	■	■	9														0	0.00
267.8	70.8	1.30					■	■	■		■	■	5						■		■			■			3	0.60
257.9	55.5	1.50	■					■			■		4							■	■			■		■	4	1.33
247.0	88.3	2.50	■	■	■	■	■	■	■	■	■	■	10														0	0.00
243.8	58.0	2.50		■			■	■			■		3	◆			◆			■	■		■	■		■	7	1.75
235.9	71.0	2.50		■			■	■	■	■	■		5						■		■					■	3	0.50
228.5	74.0	2.50		■			■	■	■	■	■		5						■		■					■	3	0.50
227.1	89.3	2.50	■	■	■	■	■	■	■	■	■	■	10														0	0.00
221.7	76.0	2.50	■	■			■	■	■	■	■		7							■	■					■	3	0.43
217.6	83.3	2.50	■	■		■		■	■	■	■	■	9														0	0.00
213.1	93.0	2.50	■	■	■	■		■	■	■	■	■	10														0	0.00
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

Project affected area

Upstream (impoundment)

Downstream

05/27/2 1

Figure 3.6-6. Qualitative Habitat Evaluation Index report for sites sampled in the Connecticut River during 2008 (Source: 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" (NEFMC, 1998), by definition including the entire Connecticut River.

3.6.7 Summary of Existing Mussel and Macroinvertebrate Studies

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

- New Hampshire and Vermont Wildlife Action Plans, 2005
- FWS Northeast Region
- 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 (*Alasmidonta heterodon*). Five of these freshwater mussel species have been identified in the Wilder 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's identification of this resource data gap during a pre-relicensing meeting. Biodrawversity and LBG surveyed the tail water below the Wilder dam (less than 1 mile below the dam) and 49 sites in the Wilder impoundment for freshwater mussels with a focus on dwarf wedgemussel.

Mussels were found at every site sampled (Biodrawversity and LBG, draft 2012; figure 3.6-7). Three species were found in the tail water, they were: eastern elliptio (*Elliptio complanata*), eastern lampmussel (*Lampsilis radiata*), and triangle floater (*Alasmidonta undulata*). Five species were found in the impoundment, they included the three species found in the tail water 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 third of the impoundment from about Piermont, New Hampshire north. Eastern elliptio was abundant throughout much of the impoundment, averaging more than 180 per site, and eastern lampmussel was numerous in the lower half of the impoundment (average of about 42 per site throughout the impoundment). Below the dam, eastern elliptio averaged about 32 mussels per site and eastern lampmussel averaged about 10.5 mussels. Creeper was the least abundant species found, with only one encountered in the Wilder Project affected area. Dwarf wedgemussel were found consistently along 14 miles of the river, from 27 to 41 miles upstream of the dam; a total of 39 animals were found in the Wilder impoundment (Biodrawversity and LBG, draft 2012).

These results were supported by previous studies; Nedeau (2006) documented dwarf wedgemussels along a 16-mile reach in the Wilder impoundment, beginning slightly further downstream than the 14-mile area identified in 2011 (Biodrawversity and LBG, draft 2012). Nedeau (2005) surveyed several sites in the Wilder impoundment from Orford to Haverhill, New Hampshire and found six species, the five found in 2011 and eastern floater. Ferguson (1999), who assessed dwarf wedgemussel distribution and habitat in large tributaries of the Connecticut River, found no live mussels in the mouth of the Waits, Passumpsic, White, or Ompompanoosuc River, though relic shells of eastern elliptio, eastern floater, or eastern lampmussel were found in the Passumpsic River and a fresh relic shell of eastern elliptio was seen in the White River.

Dwarf wedgemussel

The dwarf wedgemussel lives along the Atlantic slope from North Carolina to New Brunswick (Moser, 1993). Populations have declined precipitously over the last hundred years. Once known from at least 70 locations in 15 major Atlantic slope drainages it is now known from 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 and the Ashuelot (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 (*Etheostoma olmstedii*), johnny darter (*Etheostoma nigrum*), mottled sculpin (*Cottus cognatus*), slimy sculpin (*Cottus cognatus*), and Atlantic salmon (*Salmo salar*).

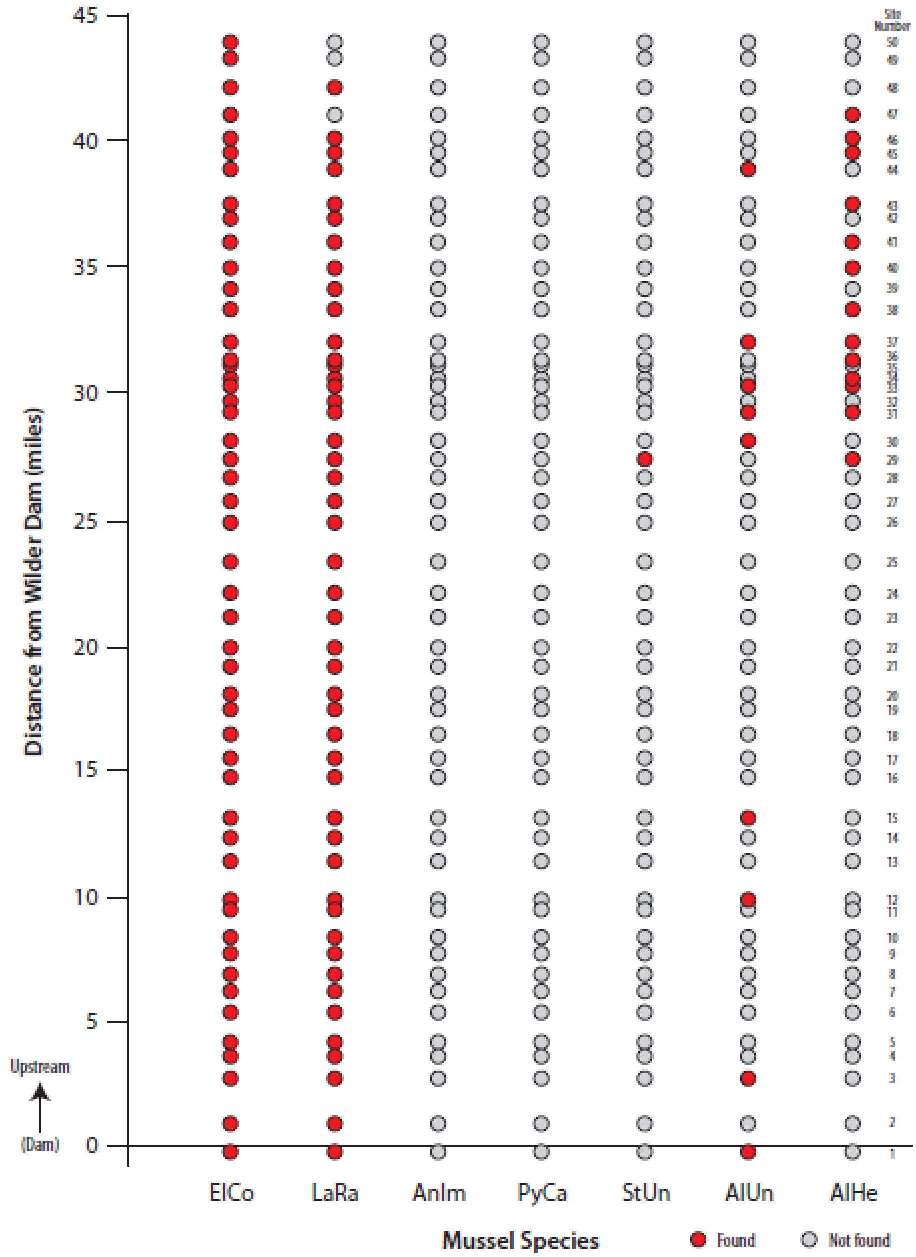

Figure 3.6-7. Survey sites where mussel species were found in the Project affected area. Species abbreviations are: ElCo = eastern elliptio, LaRa = eastern lampmussel, AnIm = alewife floater, PyCa = eastern floater, StUn = creeper, AlUn = triangle floater, AlHe = dwarf wedgemussel (Source: Biodrawversity and LBG, draft 2012).

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 listed as a federally endangered species in March of 1990. It is also listed as endangered by the states of Vermont and New Hampshire. To meet recovery objectives to (1) downlist the species to threatened status, and (2) delist, 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 endangered (FWS, 2007). On June 8, 2011 a notice of initiation of review and request for information was published in the Federal Register, initiating FWS' 5-year status reviews for dwarf wedgemussel under the ESA of 1973.

Macroinvertebrates

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, 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 3.6-5). National Rivers and Streams Assessment sampling was conducted at two locations in the Wilder impoundment: Lyme, New Hampshire, 17 miles upstream of Wilder dam, and Haverhill, New Hampshire, 41 miles upstream of the dam (D. Neils, New Hampshire DES Biological Monitoring Program Manager, personal communication).

Data summarized for these collections includes taxa richness (or abundance), total abundance of macroinvertebrates, EPT richness (total number of mayfly (Ephemeroptera), stonefly (Plecoptera), and caddisfly (Trichoptera) orders in the sample), and the percent of the sample composed 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 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

3.6-5 alone cannot be used to rate the condition of the sampled sites, a general description can be formulated.

The Wilder 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 Lyme 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. Metric values for the Haverhill site, higher taxa richness, higher EPT richness, and lower percent contribution of the dominant taxon, compared to the Lyme site, suggests a more conducive environment for macroinvertebrates, perhaps due to a slightly faster flow of water, or a more heterogeneous substrate, including cobble and large gravel substrate with interstitial sand or gravel.

Table 3.6-5. Summary metrics from benthic macroinvertebrate 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
FW08NH009	Lyme	8/20/2008	PRIMARY	taxa richness	42
				total abundance	519
				EPT richness	3
				% dominant taxon	51
FW08NH020	Haverhill	8/21/2008	PRIMARY	taxa richness	65
				total abundance	373
				EPT richness	15
				% dominant taxon	14

In 1992, Vermont DEC collected macroinvertebrate data along the west back of the Connecticut River using kick nets. None of the stations sampled were within the Wilder project affected area. However, two stations were located just outside the Project affected area and are include here as reference. One station was located 48 miles upstream of the Wilder dam (i.e., 3 miles upstream of the Project impoundment) and one station was located 3.5 miles below Wilder dam (Steve Fiske, Aquatic Biologist Vermont DEC Biomonitoring Section, personal communication).

Data calculated from the sample collections included density or abundance of macroinvertebrates, taxa richness, EPT richness, PMA-O and EPT/EPT + Chironomidae abundance (table 3.6-6). 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 show that the areas sampled just outside the Wilder project affected area in 1992 were considered non-impaired.

Table 3.6-6. Data calculated from benthic samples collected just outside 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-1600002658	48 mi above Wilder dam	886.7	43.5	24.0	80.1	0.85
CT-1300002130	3.5 mi below Wilder dam	1798.0	35.5	20.0	81.9	0.95

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 substrate (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 seconds 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/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 Wilder Project. One station, in Hewes Brook fell into this category within the Wilder project affected area (table 3.6-7).

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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.

Using baseline data from more than 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. Three samples were collected at the Hewes Brook station over nine months in 2003, using three sampling techniques (table 3.6-7). The aquatic community condition at the Hewes Brook site was found to be impaired early in the year, and non-impaired later in the year (D. Neils, New Hampshire DES Biological Monitoring Program Manager, personal communication).

Table 3.6-7. 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 26.05	Hewes Brook	0.5	01-Jan-03	K	0.88	Impaired
NH HEX 26.05	Hewes Brook	0.5	29-Jun-03	MH	1.32	Non-impaired
NH HEX 26.05	Hewes Brook	0.5	02-Sep-03	AS	0.98	Non-impaired

[a] Sample Type: K= kick net, AS= artificial substrate, MH= multi-habitat kick net

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 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. Studies of the effectiveness and survival rate for downstream passage demonstrated that Atlantic salmon smolts effectively use the downstream bypass with a high survival rate, and that the turbine passage survival rate is also relatively high.

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 2.5 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 downstream of the Project and a notable fishery exists there, though suggesting that the effects are limited.

Seven species of freshwater mussel, including the federally endangered dwarf wedgemussel, are found within the mainstem of the Connecticut River and near the mouth of mainstem tributaries. Five of those, including dwarf wedgemussel, have been identified in the Wilder Project affected area. Threats to mussel species and macroinvertebrates 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.

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3.7 WILDLIFE AND BOTANICAL RESOURCES

This section reviews existing information for the wildlife and botanical resources occurring within the vicinity of the Wilder Project. For these 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 1 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 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.

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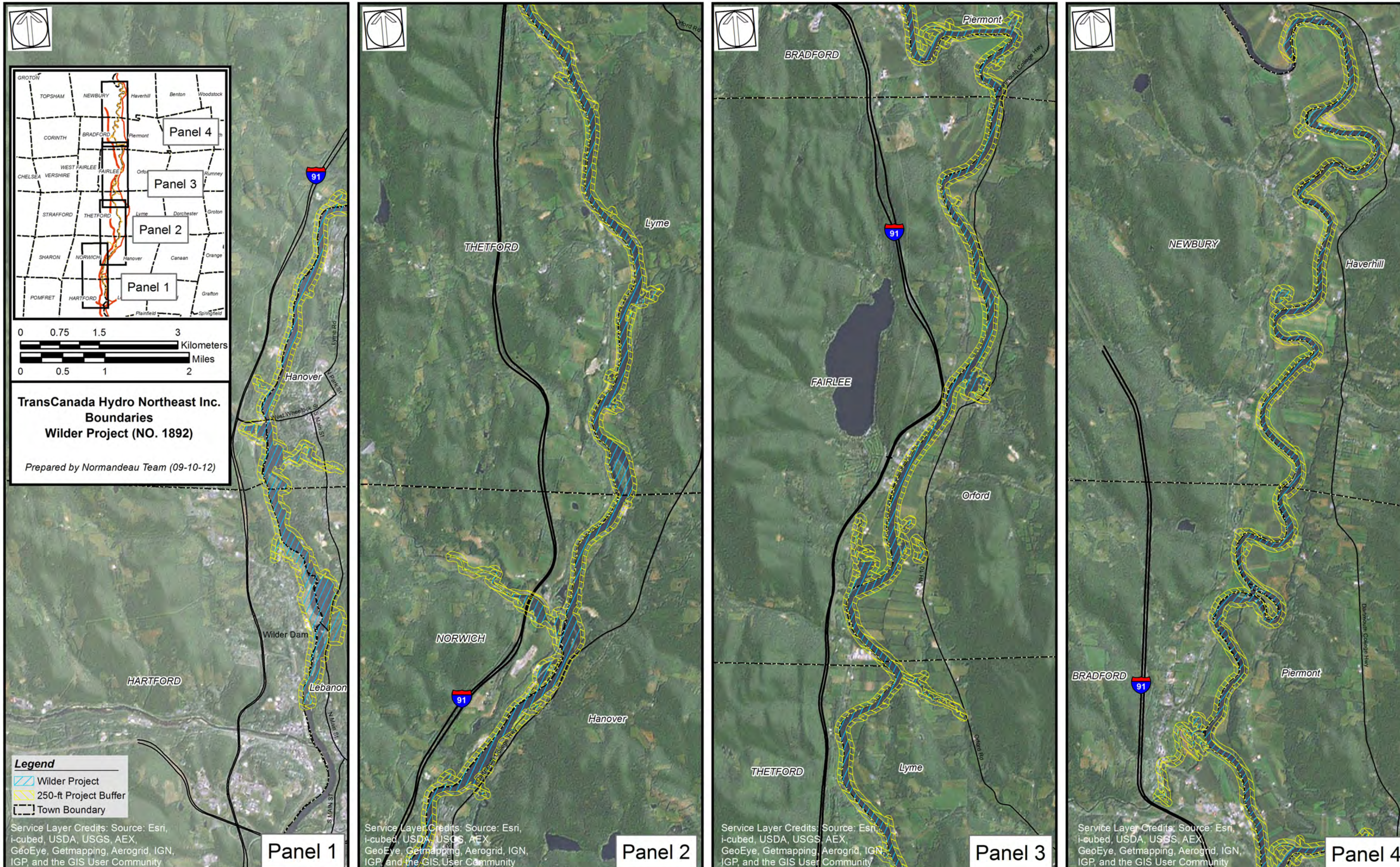

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Figure 3.7-1. Terrestrial project area.

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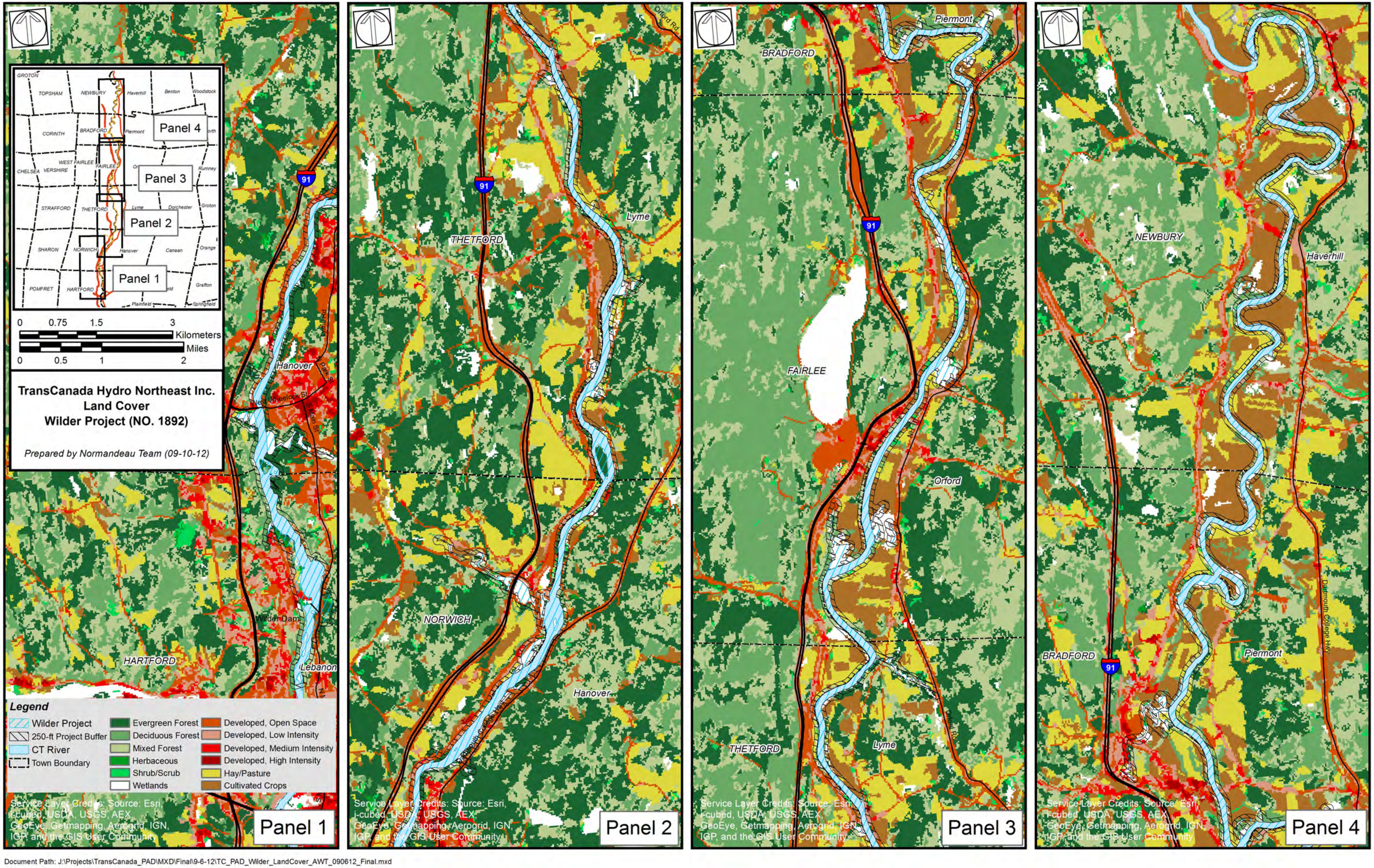

Figure 3.7-2. Land cover map.

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The total acreage of the terrestrial project area (Project boundary plus 250-foot buffer) is about 3,463 acres, excluding the open water of the river. The acreages of the various cover types using USGS maps within the project area, 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.

Table 3.7-1 Comparison of habitat and land cover layers among USGS, New Hampshire, and Vermont land cover maps.

USGS Land Cover	NH WAP	VT WAP	Acres
Forest (Mixed, Coniferous or Deciduous)	Appalachian Oak Pine Forest	Oak-Pine-Northern Hardwood Forest	1,464
	Hemlock Hardwood Pine Forest	Hemlock-Northern Hardwood Forest	
	Floodplain Forest	Floodplain Forest	
Hay/Pasture	Grassland	Grassland and Hedgerow	433
Cultivated Crops			755
Grassland/Herbaceous			19
Developed, High Intensity	*not mapped*	*not mapped*	6
Developed, Medium Intensity			55
Developed, Low Intensity			160
Developed, Open Space	*not mapped*	*not mapped*	480
Other			91
	Total Terrestrial project area		3,463

3.7.2 Wildlife Habitats

The 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, abundant hay and pasture lands create grassland habitats throughout 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 utilization of the terrestrial 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 both the New Hampshire and Vermont sides of the Connecticut River. Forest covers 1,464 acres or 42 percent of the terrestrial project area. The following sections describe the dominant cover types identified in the New Hampshire and Vermont WAPs.

Hemlock Hardwood Pine. 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).

Appalachian Oak Pine. Appalachian Oak Pine forests are associated with low elevations (<900 feet) and are most common in southern New Hampshire and southern Vermont in comparatively warmer, drier habitats (New Hampshire Fish & Game, 2005; Vermont Fish & Wildlife, 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.

Floodplain Forest. 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 project area is 116 acres, based on mapped NH WAP data. Comparable data for Vermont is not available. A detailed account of this habitat type can be found in section 3.8, *Wetlands, Riparian, Littoral and Floodplain Habitat*.

Grassland and Agricultural lands

The USGS land cover map layers show 755 acres of cultivated crops, 433 acres of hay/pastureland, and 19 acres of grassland/herbaceous comprising 35 percent of the terrestrial project area (see figure 3.7-2). These categories are all combined as Grassland 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; Vermont Fish & Wildlife, 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 (Vermont Fish & Wildlife, 2005).

Existing Upland Significant Habitats

Bald Eagle Breeding/Wintering. Bald eagles breed and overwinter in the Wilder project area. 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 six 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 project area providing stopover habitat should be considered ecologically important habitat. Several examples of such habitat include Wilder Management Area in Lyme, New Hampshire, the Reed Wildlife Management Area in Orford, New Hampshire, and the Fairlee Marsh Wildlife Management Area in Fairlee, Vermont.

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 (Vermont Fish & Wildlife, 2005), but the conversion to agriculture comes at the cost of floodplain forest habitat. Several high-quality floodplain forest habitats are found within the project area. Marks et al. (2011) identifies the habitat between the Connecticut River between Waits River confluence and the Wells and Ammonoosuc River confluences (Haverhill, New Hampshire/Bradbury, Vermont) as floodplains of high ecological value. Within this floodplain, Bedell Bridge State Park and Howards Island, New Hampshire contain high quality floodplain forests (Marks et al., 2011). Floodplain forests are discussed in more detail in section 3.8, *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 the identification of a total of 35 state-listed species within the north-south Project boundaries within 1,000 feet of the river edge (section 3.9, *Rare, Threatened and Endangered Plants and Animals*). No federally listed terrestrial species occur on the Wilder project area. Dwarf wedgemussel (federally endangered) does occur and is described in sections 3.6.7 and 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 general vicinity of the Project.

Table 3.7-2. Representative wildlife species likely to occur in the Project 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
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

Common Name	Basic Habitat Type
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
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 representative 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 Wilder terrestrial project area.

Table 3.7-3. Representative native plant species likely to occur in the Project vicinity (Source: New Hampshire Fish & Game, 2005; Sperduto and Kimball, 2011; Vermont Fish & Wildlife, 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
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

Common Name	*Scientific Name*	*Basic Habitat Type*
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 3.9-2 lists the FWS-designated Birds of Conservation Concern (BCC) for Region 14 (Atlantic Northern Forests U.S. Portion only), which includes the 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).

Based on their ranges and habitat preferences, eight species from the list have the potential to occur in the 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 Project vicinity.

Table 3.9-2. Birds of Conservation Concern for Region 14 and their potential to occur in the Project vicinity (Source: FWS, 2008; Sibley, 2000).

Common Name	Scientific Name	Potential to occur 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

Common Name	Scientific Name	Potential to occur During Breeding Season
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

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 3.7-4 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 accepts and monitors reports of invasive populations.

Table 3.7-4. Invasive plant species likely to occur in the Project 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

Common Name	Scientific Name	Habitat
Eurasian Water Milfoil	*Myriophyllum spicatum*	Aquatic
European Barberry	*Berberis vulgaris*	Field/Pasture, Early Successional Forest, Edge, Floodplain Forest
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 Wilder Project on wildlife and botanical resources can occur as a result of hydroelectric operations. The average daily water level fluctuation of 2.5 vertical feet has resulted in a zone of sparse vegetation along most of the shorelines of the impoundment. Wetland- or water-dependent wildlife and plant species will likely be adversely affected by the daily wetting and drying cycles along the river's edge. Most terrestrial wildlife and plant species use habitats at higher elevations and thus are generally above the influence of daily water level fluctuations. The disturbance resulting from both daily Project operations and high water events often creates increased opportunities for invasive plant species to colonize and dominate the shorelines of the Project. Because no changes are proposed to Project operations, no new effects on wildlife and botanical resources are anticipated.

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3.8 WETLANDS, RIPARIAN, LITTORAL, AND FLOODPLAIN HABITAT

3.8.1 Summary of Existing Studies

Mapping by the National Wetland 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 shoreland 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 (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 109 acres in the vicinity of the Project (figure 3.8-1).

Wetland cover types are divided into three sub-categories: emergent (41 acres), scrub-shrub (30 acres), and forested (38 acres).

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 will 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 utilize 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.

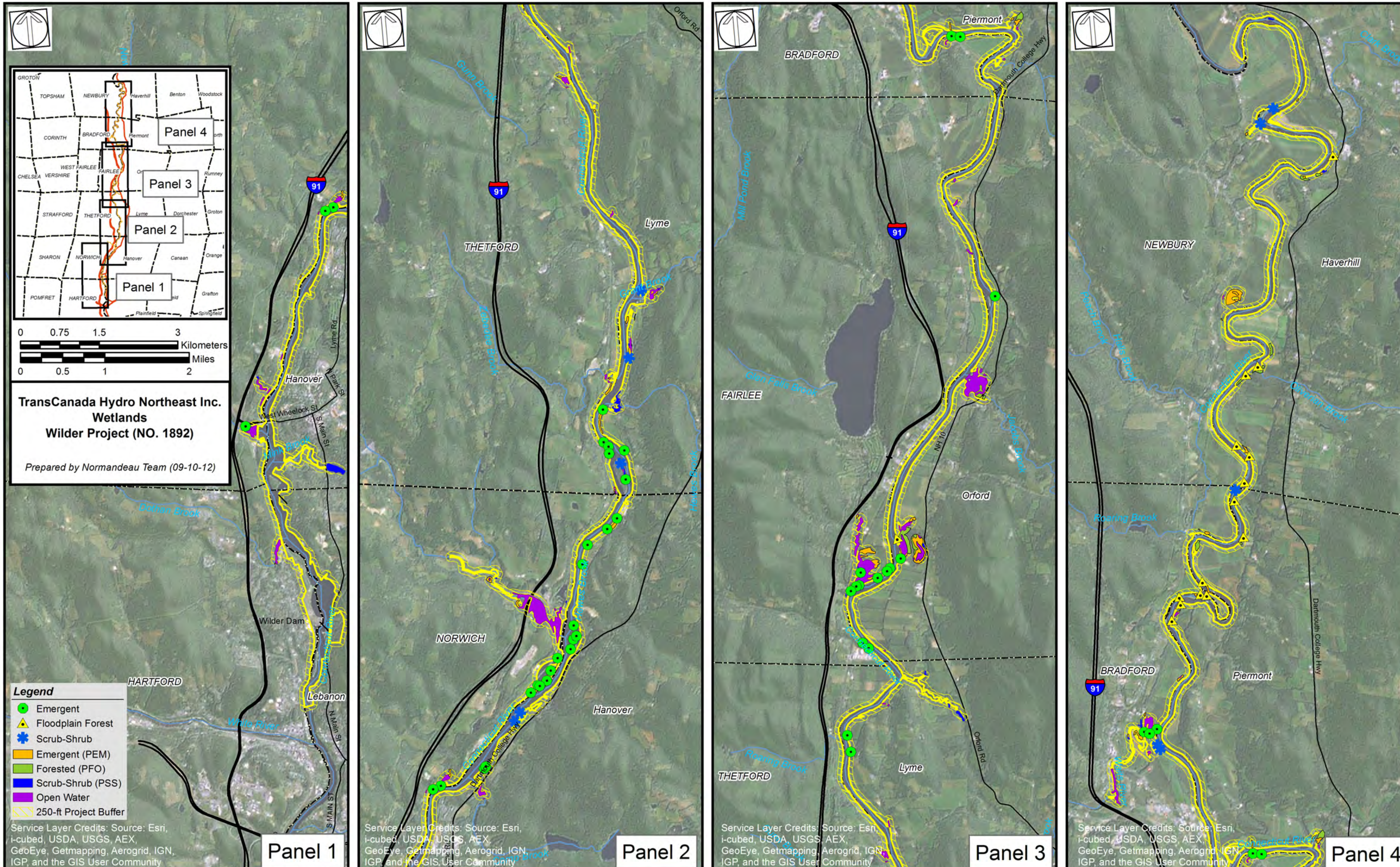

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Figure 3.8-1. Wetlands maps.

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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. Primary 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).

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)		*513*
Total Wetland		*125*[a]
	88	*103*
	37	*13*
Grassland/Herbaceous		*4*
Pasture/Hay		*115*
Cropland		*219*
Developed (Open Space, Low, Medium, or High Intensity)		*152*
TOTAL		*1,253*

[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; Vermont Fish & Wildlife, 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; Vermont Fish & Wildlife, 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 (Vermont Fish & Wildlife, 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: downstream from the confluence of the Ompompanoosuc River in Norwich, Vermont, and Fairlee Marsh and Reeds Wildlife Management Area in Fairlee, Vermont, and Orford, New Hampshire. In addition, Nedeau (2006) reported abundant submerged aquatic vegetation on the river's edge in Norwich, Vermont, near Goodrich Four Corners Road, and northward from the bridge between Newbury, Vermont, and Haverhill, New Hampshire, indicating locally wide littoral zones.

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 average daily water level fluctuation of 2.5 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. Because no changes are proposed under the new Project operations, no new effects on wetland, floodplain, riparian, and littoral resources are anticipated.

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3.9 RARE, THREATENED, AND ENDANGERED SPECIES

3.9.1 Summary of Existing Studies

Listings of all rare, threatened, and endangered (RTE) species 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 the PAD will be referred to as the RTE project area. Habitat information was derived from the Heritage Bureau'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 RTE project area was determined by consulting the map layers provided by New Hampshire NHB and Vermont NHIP. Table 3.9-1 shows the 35 species that are listed by FWS and states as occurring in the Project 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 wedge-mussel	E	E	E	Variable-sized rivers with stable flow and substrate (Nedeau 2007)
Alasmidonta varicosa	Brook floater	T	E		Sections of stream with low to moderate flow and stable substrates (Nedeau 2007b)

Scientific Name	Common Name	VT Status[a]	NH Status[a]	Federal Status[a]	Habitat
Vertebrate Animals					
Glyptemys insculpta	Wood turtle		SC		Meandering streams with sandy bottoms (DeGraaf and Yamasaki)
Haliaeetus leucocephalus	Bald eagle	E	T	P[b]	Large lakes, rivers; large, riparian trees for nesting, roosting (DeGraaf and Yamasaki)
Podilymbus podiceps	Pied-billed grebe		T		Freshwater ponds with large areas of emergent vegetation, marshy edges of rivers/lakes (DeGraaf and Yamasaki)
Plants					
Acer nigrum	Black maple		T		Floodplain forest; rich woods and talus
Arisaema dracontium	Green-dragon	T	E		Floodplain forest (NHNHB) rich wet or mesic upland and alluvial woods (Magee and Ahles)
Bromus kalmii	Kalm's brome		E		Sandy or gravelly open soil, open woodlands and thickets (Magee and Ahles).
Calystegia spithamaea	Upright false bindweed	T	E		Fields and disturbed areas
Cardamine maxima	Large toothwort		T		Rich, moist woods (Magee and Ahles)
Cynoglossum virginianum ssp. boreale	Wild hound's-tongue	T	E		Open woods (Magee and Ahles)
Cypripedium arietinum	Ram's-head lady's-slipper	T	E		Wooded swamps, moist deciduous woods (Magee and Ahles)
Diplazium pycnocarpon	Narrow-leaved glade fern		E		Rich wooded slopes, ravines, and rocky woods (Magee and Ahles)
Galearis spectabilis	Showy orchid		T		Rich, deciduous woods (Magee and Ahles)

Scientific Name	Common Name	VT Status[a]	NH Status[a]	Federal Status[a]	Habitat
Gentianella quinquefolia	Stiff dwarf-gentian		E		Rich woods and talus; rich wet meadow; calcareous riverside seeps
Geum fragarioides	Appalachian barren-strawberry		T		River or stream floodplains, shores of rivers or lakes, woodlands (Magee and Ahles)
Glyceria acutiflora	Sharp manna-grass	E	E		Shallow water of ponds and streams, wet soil (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 (NHNHB); Quiet water (Magee and Ahles)
Hydrophyllum virginianum	Eastern waterleaf		T		Rich, deciduous, often wet woods (Magee and Ahles)
Isoetes riparia var. canadensis	Canada shore quillwort		E		Aquatic bed; Sandy pondshores / Sand plain basin marshes; Brackish marshes, mudflats, and borders
Lobelia kalmii	Brook lobelia		T		Calcareous pond and stream margins, wooded swamps, wet woods (Magee and Ahles)
Nabalus serpentarius	Lion's-foot rattlesnake-root		E		Dry open woods and thickets (Magee and Ahles)
Nuphar microphylla	Small-leaved pond-lily		E		Ponds (Magee and Ahles).
Panax quinquefolius	American ginseng		T		Rich woods (Magee and Ahles)
Potamogeton alpinus	Reddish pondweed		E		Calcareous ponds and slow streams (Magee and Ahles)
Potamogeton nodosus	Long-leaved pondweed		T		Aquatic bed (NHNHB); shallow or deep ponds and streams (Magee and

Scientific Name	Common Name	VT Status[a]	NH Status[a]	Federal Status[a]	Habitat
					Ahles)
Potamogeton vaseyi	Vasey's Pondweed		E		Quiet water (Magee and Ahles)
Pterospora andromedea	Pine-drops	E	E		Dry, pine woods (Magee and Ahles)
Quercus macrocarpa	Mossy-cup oak		E		Bottomlands and moist to dry, rich woods (Magee and Ahles)
Sagittaria cuneata	Northern arrowhead		E		Aquatic bed; Medium-depth and deep emergent marsh; northern riverbanks
Sagittaria rigida	Sessile-fruited arrowhead		E		Aquatic bed; Sandy pondshores / Sand plain basin marshes (NHNHB); Swamps and fresh or brackish mud or shallow to deep water (Magee and Ahles)
Sanicula odorata	Clustered sanicle		E		Rich woods (Magee and Ahles)
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 borders (NHNHB); shallow lakes, ponds and quiet rivers (Magee and Ahles); limey pools (Seymour)

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

[b] 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 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. Green dragon and black maple have been observed in floodplain forest areas along the Connecticut River, taking advantage of the rich, mesic forested habitat. Sandy and gravel river banks provide habitat for the sandbar willow. Finally, marshy, littoral river margins provide habitat for pondweeds (*Potamogeton spp.*) 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 Project vicinity. The State of Vermont has developed recovery plans for several bird species known to use the Project area: the bald eagle, state-listed as 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 Project area: Reeds WMA and Fairlee Marsh WMA in Orford, New Hampshire/Fairlee, Vermont, and downstream of the Waits River confluence.

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 (Martin, 2010). In Fairlee, Vermont / Orford, New Hampshire, nesting has occurred since 2009 with four successful years and a total of eight fledged young. Two of these chicks fledged in 2010 to a six year old male and an unbanded female (Martin, 2010). A territory in Newbury, Vermont/Haverhill, New Hampshire, was discovered in 2012, but it was unsuccessful in its first year (C. Martin, personal communication, August 14, 2012).

Dwarf Wedgemussel. A recovery plan has been written by FWS for this federally 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 endangered (FWS, 2007).

In 2011, Biodrawversity LLC conducted a freshwater mussel survey throughout the Wilder impoundment and downstream to the lower limit of the Vernon Project (Biodrawversity LLC and LBG, 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 50 sites were surveyed, one site below Wilder dam and 49 sites within the Wilder impoundment. Dwarf wedgemussels were found at 13 sites located 27 to 41 miles upstream of Wilder dam. None were found at the downstream site (Biodrawversity LLC and LBG, 2012). For more detail, see section 3.6.7, *Mussels and Macroinvertebrate Surveys*.

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).

None of these sites are located within the Project RTE project area; however, flows from the Project could impact these sites. The Jarvis Hill site lies within the Bellows Falls Project at the most upstream extent of the impoundment. 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) estimate their elevation relative to daily Project operations to evaluate the potential influence of Project operations on rare species and communities (Normandeau, 2012b, in progress). 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 Project 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 2.5 vertical feet has resulted in a zone of sparse vegetation 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 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 Wilder (700 to 10,500 cfs). The average yearly peak flow 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 area. 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

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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 the Wilder reservoir within the Project boundary and about 1 mile downstream of Wilder dam.

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

- Wilder 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 Two-Rivers-Ottauquechee Regional Plan;
- 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 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 New Hampshire Route 10 runs along the New Hampshire side providing highway access throughout the Connecticut River Valley. The tracks of the Boston and Maine Railroad run along the Vermont side nearly paralleling U.S. Route 5. 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, swimming, hiking, bicycling, picnicking, sightseeing, wildlife viewing, canoe/kayaking, snowmobiling, Nordic skiing, and hunting. The Project area's primary recreation facilities and use are focused around the Connecticut River including Wilder reservoir. The Connecticut River Water Trail travels along the full length of the Connecticut River in Vermont and New Hampshire. CRJC 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).

Wilder reservoir extends north from Wilder dam in West Lebanon, New Hampshire, and Hartford (Wilder village), Vermont, about 46 miles to just downstream of the villages of Wells River, Vermont, and Woodsville, New Hampshire (see figure 2.1-1 for general reference). Wilder reservoir has about 107 miles of shoreline with a surface area of 3,100 acres at a normal pond elevation of 385 feet (top of stanchion boards) and is largely surrounded by private lands. The Project is situated in parts of 12 communities: Lebanon, Hanover, Lyme, Orford, Piermont and Haverhill in New Hampshire; and Hartford, Norwich, Thetford, Fairlee, Bradford and Newbury in Vermont. Recreation access to the reservoir is provided in almost every town except Piermont in New Hampshire, and Fairlee and Newbury in Vermont.

The primary activities that occur at Wilder reservoir include camping, fishing, hiking, boating (motorized and canoe/kayaking), swimming, hunting, and winter sports such as ice fishing, snowmobiling, and Nordic skiing, and ice skating. Boating on the reservoir is very popular with numerous access points for both trailered motor boats and cartop/hand launch canoe/kayak trips. Table 3.10-1 summarizes the Project and Project-related public recreation facilities that provide access to the Wilder 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 Wilder reservoir or other Project lands. The majority of the recreation sites are modest with few amenities other than access to the river to fish or launch a boat.

Wilder dam creates a long reach for power boat and jet ski travel. The Connecticut River is also very popular for canoeing and kayaking (CRJC, 2008), and this reach of the river offers easy flat-water paddling. The Connecticut River Boating Guide describes this reach as "lovely and winding" where one "may find your mind drifting along with the slow current." Rowing and sculling are becoming very popular on the river, particularly at Hanover, where Dartmouth College and Hanover High School crew teams practice and race (CRJC, 2008). The Upper Valley Rowing Foundation offers summer rowing classes for the public and hopes to develop a facility on the river in the future. Other classes and events are held using new rowing docks at the Chieftain Motor Inn in Hanover. The Ledyard Canoe Club offers canoe and kayak rentals near the bridge in Hanover. A 1,000-foot no-wake zone above the Ledyard Bridge protects swimmers and small craft.

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

Between Bradford, Vermont, and Piermont, New Hampshire, downstream to Sawyer's Ledge in Fairlee, Vermont, the river is usually too narrow for legal travel over headway speed. From Sawyer's ledge to just below the outlet from Storrs Pond near the Chiefton Motor Lodge in Hanover, New Hampshire, the river can accommodate power boating. Downstream from the Storrs Pond outlet, the river is often too narrow for travel over headway speed. Between the Ledyard Bridge, at the downstream end of the no-wake section, and Wilder dam, the river is once again wide enough for power boating.

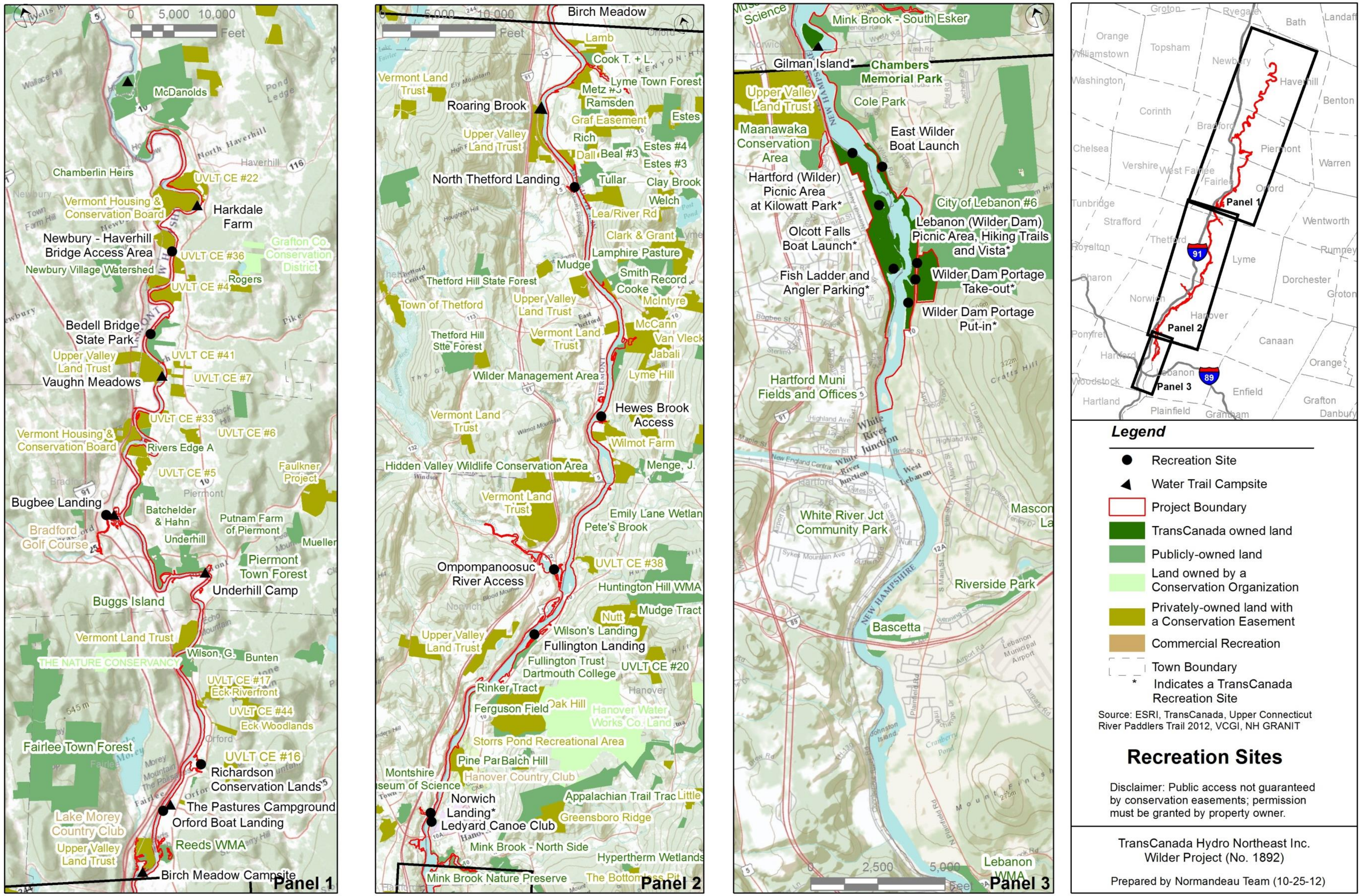

Figure 3.10-1. Recreation sites and lands within the Project vicinity.

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Table 3.10-1. Recreation sites within the Project boundary (Sources: CRJC, 2008; Pollock, 2009).

Site Name	Site Type	RM	Town	Manager
Newbury-Haverhill Bridge Access	Boat ramp (improved)	257.5	Haverhill, VT	VTDFG
Bedell Bridge State Park	Boat ramp (improved) and picnicking	255	Haverhill, NH	NH Parks and Recreation
Bugbee Landing Access Point	Ramp (small dock with unimproved ramp)	248	Bradford, VT	VTDFG
Orford Boat Landing	Boat ramp (improved)	239	Orford, NH	Town of Orford with NH Fish & Game Dept.
Richardson Conservation Land	Boat launch (walk in carry/car-top access)	234	Orford, NH	Town of Orford
North Thetford Landing	Boat ramp (improved)	232.5	Thetford, VT	State of VT
Hewes Brook Boat Launch	Boat launch (car-top access)	228	Lyme, NH	Lyme Conservation Commission
Ompompanoosuc Launch	Boat launch (unimproved ramp)	225	Pompanoosuc, VT	State of VT
Norwich Landing*	Boat launch (car-top access)	216	Norwich, VT	Town of Norwich
Fullington Landing	Boat Ramp (improved)	221	Hanover, NH	NH Fish & Game Dept.
Ledyard Canoe Club	Canoe launch	218.5	Hanover, NH	Dartmouth College

Site Name	Site Type	RM	Town	Manager
East Wilder Boat Launch*	Boat Ramp (improved)	216	West Lebanon, NH	City of Lebanon
Hartford (Wilder) Picnic Area at Kilowatt Park*	Small dock and day use area	219.3	Hartford, VT	Town of Hartford, VT
Wilder Dam (Olcott Falls) Boat Launch*	Boat launch (improved), athletic fields and picnic facilities	216	Hartford, VT	Town of Hartford, VT
Fishladder & Angler Parking*	Angler access	215	Hartford, VT	TransCanada
Lebanon (Wilder Dam) Picnic Area, Vista, and hiking trails*	Day use (hiking and picnicking)	215	West Lebanon, NH	TransCanada
Wilder Dam Portage and downstream natural areas*	Portage trail, angler access, and natural area	215.5	West Lebanon, NH	TransCanada

Notes: * indicates TransCanada recreation site as noted on the current FERC approved Exhibit R – Recreation Map.

Power boat wakes are one of the key causes of bank erosion on the main stem of the river above Wilder dam (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. Walleye in particular provide a significant fishery in the tailrace at Wilder dam (New Hampshire Fish & Game, 2010). Fish passage facilities now provide for the passage of anadromous fish and native species; section 3.6, *Fish and Aquatic Resources*, provides a detailed discussion related to anadromous fish in the Connecticut River. New Hampshire fishing licenses or Vermont resident licenses are required for the Connecticut River, and they 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 the U.S. Environmental Protection Agency, conducted a water quality assessment of the entire river in New Hampshire in 2004. Section 3.5 *Water Resources*, provides a detailed discussion of this study. The river was found to be safe for swimming throughout the project area from Bradford and Piermont down to the mouth of the White River below Wilder dam. Swimming occurs anywhere there is access to the river. The Ledyard Boathouse in Hanover has a designated (roped) swim area.

About 9 miles downstream of Wilder dam, outside the Project boundary, is Sumner Falls (or Hartland Rapid), which presents a series of ledges sprawled across a wide section of the Connecticut River. The exposed bedrock in the area creates a quarter mile stretch of rapids used by whitewater boaters as the river drops 7 vertical feet over the short distance. According to boating guides, the run is known as a reliable summer play spot, is boatable at almost any water level, and can accommodate a range of boater abilities. Open-faced boats and canoes should portage the ledges. The site is also popular with anglers and, during more modest flows, swimmers.

Land-Based Recreation in the Vicinity of the Project

TransCanada holds fee ownership of 123 acres of land in the Wilder Project. Of this, 43 acres are used for plant facility area (including about 15 acres of land extending 0.5-mile below Wilder dam along both sides of the river for angler access and public day use), 59 acres for public outdoor recreation use, 10 acres have been licensed to Dartmouth College for recreation use, and 11 acres are retained in a natural state. Public recreation lands include 30 acres on the side of Bald Hill adjacent to Wilder dam in West Lebanon, New Hampshire, preserved essentially in a natural state with the exception of the Bald Hill Hiking Trail; and a network of hiking and nature trails that originate from the Wilder dam picnic area. Project exhibit R recreation maps are included in Attachment 2 to this PAD.

During the warmer summer months through-project canoeing is common and canoe-only river camping is popular along the Connecticut River Water Trail. The Upper Valley Land Trust with support from CRJC and TransCanada created a string of seasonal, primitive canoe campsites along the Connecticut River including within the Wilder Project beginning in 1992. Primitive canoe campsites open to the public are shown in table 3.10-2. There is no charge for use of the campsites, which are available on a first-come, first-served basis with a limit of two nights per site. The campsites are intended for canoe and kayak access from the river only, although power boaters sometimes use the sites. One such site is located on TransCanada's Gilman Island, upstream of the dam, which TransCanada maintains. TransCanada maintains a canoe portage trail around the east side of the dam. Visitors to the west side of Wilder dam can visit the fish ladder viewing window which provides a look into the upstream passage by anadromous and other resident fish.

Trails in the Connecticut River Valley are enjoyed by hikers, walkers, joggers, mountain bikers, snowshoers, Nordic skiers, and snowmobilers (CRJC, 2008). Every town in the region offers trails enriched by views of the river (CRJC, 2008). Hiking opportunities exist on a number of trails that run near the river and adjacent to the Project boundary. Many towns and communities have published maps showing hiking trails along the Connecticut River, and the Upper Valley Land Trust has created a network of trails across private property open to the public. Some of the hiking opportunities adjacent to the Wilder Project include:

- The Appalachian Trail, which crosses the Project and is discussed in more detail below.
- Montshire Science Museum, which provides hands on opportunities related to the natural and physical sciences, ecology and technology, has a number of trails. The 110 acre site in Norwich, Vermont has a dedicated river walk trail; about one mile long with stops and viewpoints along the Connecticut River.
- The Bald Mountain Trail, which originates from the Lebanon Picnic Area and Vista near Wilder dam. The trail connects to a network of trails in adjoining Town of Lebanon lands to the east including Boston Lot Lake.
- Dartmouth College owns land along the Project just upstream of Ledyard Boat club and provides hiking trails in the vicinity.
- The Town of Hartford, Vermont has a license agreement from TransCanada for Kilowatt Park which in addition to providing boater access to the river includes a network of trails connecting the north and south portions of the park. The park also provides athletic fields, natural areas, picnic areas and restrooms.

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 as over 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).

Table 3.10-2. Connecticut River water trail campsites (Source: Pollock, 2009).

Campsite Name	Town	Manager/ Maintenance	RM	Capacity	Amenities
Harkdale Farm	Newbury, VT	Upper Valley Land Trust	259.5	12	Cleared tent site, box privy, fire ring, picnic table
Vaughn Meadows	South Newbury, VT	Upper Valley Land Trust	254	12	Cleared tent site, box privy, fire ring, picnic table, shallow beach
Bugbee Landing	Bradford, VT	Bradford Elementary School	248	12	Fire ring; privy located at adjacent fairground
Underhill Camp	Piermont, NH	Piermont Conservation Commission	245	12	Cleared tent site, box privy, fire ring
Pastures Campground	Oroford, NH	Private landowner	239	unknown	unknown
Birch Meadow	Fairlee, VT	Hulbert Outdoor Center; Upper Valley Land Trust	236.5	12	Cleared tent site, box privy, fire ring, picnic table with shelter/lantern supports
Roaring Brook	Thetford, VT	Upper Valley Land Trust	234	12	Cleared tent site, box privy, fire ring, picnic table with shelter/lantern supports, simple dock
Gilman Island*	Hanover, NH	TransCanada	217.5	10	Cleared tent site, privy, fire ring, picnic table
Gilman Island - Titcomb Cabin	Hanover, NH	Ledyard Canoe Club	215	10	Reservations required

Notes: * indicates TransCanada recreation site as noted on the current FERC-approved Exhibit R – Recreation Map.

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" such as Reed's Marsh in Orford, New Hampshire, or at the mouths of tributaries, such as the Ompompanoosuc River (CRJC, 2008). Connecticut River Birding Trail designated observation sites are located in both Vermont and New Hampshire, including Audubon Society recognized important bird areas. Birding trail stops within the Project include:

- Ompompanoosuc River Mudflats (Norwich, Vermont)
- Reeds Marsh Wildlife Management Area (Orford, New Hampshire)
- Hewes Brook Wetland (Lyme, New Hampshire)
- Wilder Wildlife Management Area (Lyme, New Hampshire)
- Mink Brook Nature Preserve (Hanover, New Hampshire)

New Hampshire and Vermont have enacted reciprocal migratory waterfowl hunting rights for licensed waterfowl hunters in a Connecticut River Zone. 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 New Hampshire laws. It is illegal to use lead shot while hunting migratory waterfowl.

During the winter months, recreation continues throughout the Connecticut River Valley as Nordic skiing and skating, snowmobiling, ice skating and ice fishing are all very popular on the Connecticut River and shoreline. 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 popular with the seasonal placement of ice fishing shanties on the river ice.

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 210,000 recreation days with a peak weekend average of 4,000.

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 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 New Hampshire DES. The Shoreland Water Quality Protection Act addresses all construction and building within this buffer including residences, docks, building setbacks, erosion control during construction projects, and vegetation maintenance. All activities that are regulated by New Hampshire DES must 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, 1997a). 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 Needs Identified in Management Plans

Management plans that cover recreation resources within the Project vicinity include the New Hampshire and Vermont SCORP, Connecticut River Management Plan (prepared by the CRJC), Upper Valley Lake Sunapee Regional Planning Commission Management Plan, and the Two Rivers-Ottauquechee Regional Commission Management Plan.

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

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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.

- Education of recreational users, municipalities, and landowners about responsible behavior, laws, and liability

- Impacts of existing land use patterns on recreational opportunities

- 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 for 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 continues to allow access to their land for public recreation
- 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, including:

1. Access areas of 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.
7. Adequate boat speed enforcement is needed.

Connecticut River Management Plan (CRJC)

Recreation priorities identified in the Connecticut River Management Plan include the following:

1. Ensure that new riverfront recreational facilities maintain a healthy riparian buffer and keep parking well back from the river.
2. Reduce mercury contamination in the Connecticut River system.
3. Protect shoreline and riparian buffers.
4. Increase enforcement of boating laws.

5. Provide boat washing stations to reduce threat of invasive aquatic species.
6. Provide consistent review of dock construction on both sides of the river.
7. Discourage construction of beaches.
8. Discourage use of "jet skis" on the river.
9. Discourage further construction or expansion of boat ramps for trailered boats; encourage new car-top boat access.
10. Invest in land conservation to ensure that open space remains for public recreation.

According to CRJC (2008), adequate public access to the Connecticut River in the area of the Wilder Project for motor boats already exists. There are major public boat ramps in nearly every town (other than Fairlee, Vermont, and Lyme, New Hampshire) where the river is wide enough to accommodate power boat traffic (Orford, Thetford, Norwich, Hanover, Lebanon, and Hartford, Vermont). These access points are spaced no more than 7 miles apart. The subcommittee responsible for preparing the recommendations relevant to the Wilder section of the river believes that adding further access for trailered boats will create additional boating conflicts, contribute to water quality problems, and strain the already limited and inadequate enforcement ability of New Hampshire Marine Patrol. The state of New Hampshire generally does not approve permits for boat launches or ramps for private use since the potential for long-term water quality degradation resulting from them is so great (CRJC, 2008). For this reason, and because of inadequate Marine Patrol presence on the river, the CRJC (2008) recommends that no further private boat ramps should be approved on the Connecticut River.

The Connecticut River Management Plan also 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 currently no public boat access in Piermont, where the river is suitable only for very shallow draft boats, or in Fairlee, where the riverbank is largely very steep or public access is cut off by the railroad.

Overall, the Connecticut River Management Plan (2008) concluded that boat landings sometimes suffer from litter problems, and there is occasional vandalism. The 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.

Upper Valley Lake Sunapee Regional Planning Commission (NH)

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. 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 issues that arise. It is the goal of this Regional Planning Commission 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 soliciting input into a regional plan, which is not yet available.

Two Rivers-Ottauquechee Regional Commission (Vermont)

The Two Rivers-Ottauquechee Regional Commission (TRORC) Regional Plan adopted June 27, 2012, identifies goals, policies and recommendations for the towns within its region. Towns served along the Wilder Project in Vermont include: Newbury, Bradford, Fairlee, Thetford, Norwich, and Hartford. The TRORC Regional Plan identifies within its recreation section the following two goals and two policies related to recreation and land use relevant to the Connecticut River.

Goals:

- To develop greenways that provide corridors for wildlife habitat as well as recreational areas for hiking, biking, and cross-country skiing.
- To maintain the tradition of public access with permission to private land that is important to the quality of life, the economy, and sense of community in the region.

Policies:

(2) Consistent with property rights, ownership and management practices which maintain or enhance public access to and uses of recreational amenities on privately held land are encouraged.

(4) The Regional Commission encourages planning and construction of recreational opportunities on sites of public utilities or public works facilities (e.g., incorporation of trail networks into public utility corridor planning) to achieve more efficient and productive use of these lands.[6]

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 who could develop the Connecticut River Paddlers Trail; developing a better understanding of the location of existing access and campsites; assessing gaps in camping and access sites; and developing guidelines for the establishment of new sites. The assessment characterized paddling resources within the Wilder reservoir as such:

[6] Policies not relevant to the Project have been omitted.

> Situated in the most populated section of the Upper Valley, [the section of the river upstream of Wilder dam] . . . is used heavily used by local residents. Access and campsites also appears to be sufficient in this reach. TransCanada Hydro Northeast provides a campsite at Gilman Island, and the UVLT [Upper Valley Land Trust] manages both a small site on Burnap Island and a group campsite at Burnham Meadows by local residents. The city of Lebanon is working to secure public access at a site currently under development by a private business owner. However, due to its proximity to Gilman and Burnap Islands, it is not a high priority as a location for an additional campsite (Pollock, 2009, p. 26).

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 which 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. There are no designated special focus areas along the Connecticut River within the Wilder Project area.

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 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 (north of Wilder dam), and 12A (south of Wilder dam) 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. The state of Vermont has opened a downtown visitor center in the White River Junction train station, sharing the history and appeal of this community and its neighbors.

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). In January 1982 (and later updated in 1995), under the National Rivers Inventory the only reach of the Connecticut River listed in the Project area based on hydrologic criteria, was from the confluence of the Ompompanoosuc River upstream to South Newbury.

State Protected River Segments

The Connecticut River from Fourth Connecticut Lake to the Massachusetts state line has been designated into the New Hampshire Rivers Management and Protection Program (RSA 483). This program 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 allowances for 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." Segments within the Wilder 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.

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 boundary 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.

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 or recreation. The Connecticut River is also designated as an American Heritage River and is also part of a national fish and wildlife refuge (see earlier discussion of the Silvio O. Conte National Wildlife Refuge).

The Appalachian National Scenic Trail

The Appalachian Trail crosses the Project using the Ledyard Bridge between Norwich, Vermont, and Hanover, New Hampshire. This 2,174-mile-long National Scenic Trail is a continuous marked footpath from Springer Mountain in Georgia to the summit of Katahdin in Maine. The Appalachian Trial is a component of both the National Trails System and a unit of the National Park System. The trail enters the area in Hartford and Norwich, Vermont; passes through downtown Hanover, New Hampshire; and continues north through Lyme, Orford, and Piermont, New Hampshire.

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 900 ponds, lakes, or reservoirs (surface water) that have the potential to provide a water-based recreation experience. It is important to note, however, that 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 Wilder Project. There are about 55 lakes, ponds, or reservoirs larger than 250 acres within the 60-mile 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 (greater 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 Wilder Project in New Hampshire and Vermont which are shown in figure 3.10-2.[7] There are 60 state or

[7] Although conservation easements are known to exist in both states, only New Hampshire made data pertaining to those easements on private lands readily

national parks or forests with some portion of their land area within the 60 mile extent of the Project 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 2 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 3.10-3, the towns within this area provide an additional 4.4 square miles of lands for recreation purposes.

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available to publish in this document at the time of printing. Conservation easements are shown in relation to recreation sites in figure 3.10-1.

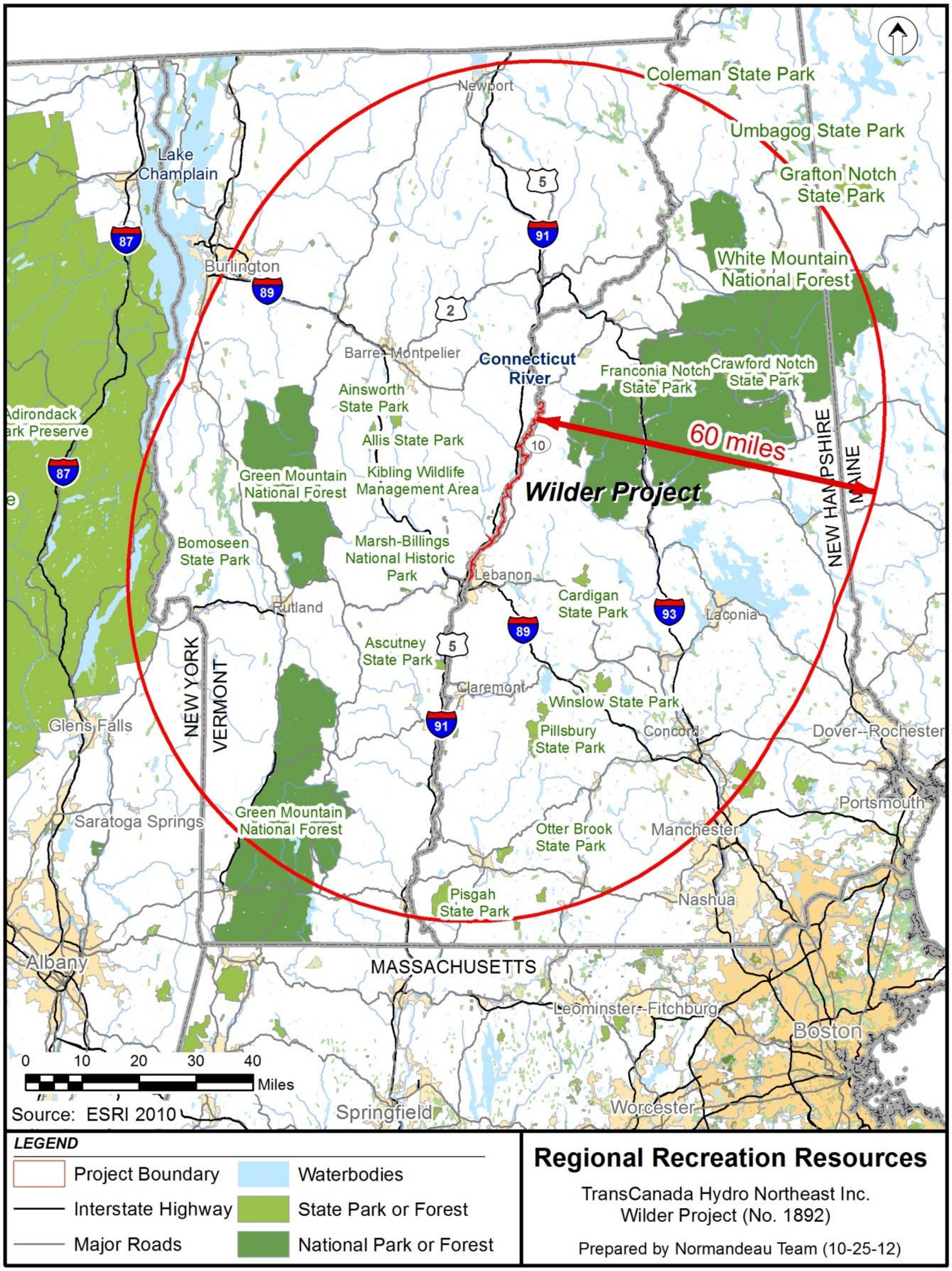

Figure 3.10-2. Land- and water-based recreation opportunities within 60 miles of the Project.

Table 3.10-3. Reservoirs, lakes, and ponds larger than 250 acres and within 60 miles of the Project.

Lake	Acres
Lake Champlain[a]	271,789
Lake Winnipesaukee	50,784
Lake George[a]	27,206
Squam Lake	8,864
Lake Memphremagog[a]	6,746
Moore Reservoir	5,581
Sunapee Lake	5,357
Winnisquam Lake	4,979
Newfound Lake	4,787
Franklin Falls Reservoir	3,878
Blackwater Reservoir	3,776
Ossipee Lake	3,558
Lake Wentworth	3,162
Lake Bomoseen	2,906
Kezar Lake	2,413
Fifteen Mile Falls Reservoir	2,138
Seymour Lake	2,099
Lake Willoughby	2,093
Somerset Reservoir	2,080
Mascoma Lake	1,645
South Bay	1,523
Highland Lake	1,459
Merrymeeting Lake	1,427
Conway Lake	1,357
Nubanusit Lake	1,338
Lake Saint Catherine	1,318
Waterbury Reservoir	1,318
Lake Dunmore	1,203
Silver Lake	1,178
Surry Mountain Lake	1,152
Kezar Pond	1,114
Chittenden Reservoir	1,069
Caspian Lake	1,062
Green River Reservoir	1,056
Province Lake	1,037
Lower Bay	1,030
Maidstone Lake	1,005
Goose Pond	890
Lake Groton	819
Lake Hortonia	781
Mollys Falls Pond	781
Norton Pond	755
Lake Salem	717
Deering Reservoir	704
Crystal Lake	691
North Springfield Reservoir	678
Lake Fairlee	659
Island Pond	659
Shelburne Pond	621
Pine River Pond	570
Hopkinton Lake	531
Berlin Pond	531
Lovewell Pond	416
Lake Rescue	333
East Bay	320

[a] Limited portion within the 60-mile radius of the Project.

Table 3.10-4. National, state, or county parks or forests larger than 2 square miles and within 60 miles of the Project.

Name	Square Miles
National Park or Forest	
Green Mountain National Forest	974.4
White Mountain National Forest	1,381.4
State Park or Forest	
Adirondack Park Preserve[a]	8,845.9
Ainsworth State Park	3.8
Allis State Park	3.3
Ascutney State Park	3.8
Bear Brook State Park	20.6
Bomoseen State Park	5.6
Cardigan State Park	5.0
Crawford Notch State Park	8.4
Franconia Notch State Park	10.1
Monadnock State Forest	2.7
Mount Sunapee State Park	3.7
Otter Brook State Park	4.5
Pillsbury State Park	8.3
Pillsbury State Forest	8.2
Pisgah State Park	19.8
Winslow State Park	6.7
County Park or Forest	
Kibling Wildlife Management Area	2.6

[a] Limited portion within the 60-mile radius of the Project.

3.10.8 Non-recreational Land Use and Management within the Project Boundary

TransCanada owns 123 acres of land in the Project, all of which are located around Wilder dam. Project operations and maintenance are the primary non-recreational activities that occur in the Project area around Wilder dam. Maintenance activities include road and building 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 lands within the Project area. These permitted uses include 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 is provided by the states of Vermont and New Hampshire (e.g., state parks, wildlife management areas, visitor centers), neighboring towns (park facilities in Hartford, Vermont, and Lebanon, New Hampshire, including ballfields, picnic areas, horseshoe pits, and vehicle parking), and golf courses.

The Wilder impoundment extends upstream about 46 miles from the dam in a classically New England pastoral setting. Bottomland agriculture is the dominant land use in the Project area. Prime agricultural soils in the corridor are believed by some to be the best agricultural soils located in either state (CRJC, 1997b). The agriculture is a mix of dairy, vegetable, and hay farming operations. Most of the residential housing found in the corridor is single-family homes with only scattered housing occurring in the northern section of the Project area. Figure 3.7-2 shows generalized land cover types for lands in the Connecticut River Valley in the Wilder Project area. Higher density development, including commercial/industrial development, occurs primarily in Hanover, Lebanon, and the White River Junction area of Hartford downstream of Wilder dam although even there, there are areas where no development can be seen from the river (CRJC, 1997b).

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, crew team competition, tackle shops, and nordic skating) 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 its existing FERC license) identify public access areas and open space within Wilder impoundment and downstream of Wilder dam in the Project boundary.

Flows in this section depend upon tributary inflow contribution and operations at the upstream Fifteen Mile Falls Project dams and at Wilder 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 382.5 feet from Friday at 4 pm through Sunday at midnight. 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 Wilder 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.

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 the 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 effects on recreation resources associated with the Project as proposed.

3.10.11 References

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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 Wilder dam and reservoir within the Project boundary.

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

- 1970 FERC license application for the Wilder Project;
- Wilder exhibit R maps;
- CRJC Connecticut River Corridor Management Plan; Recreation Plan; Water Resources Plan, and Boating on the Connecticut River Maps;
- Regional planning documents, including Two-Rivers-Ottauquechee Regional Plan; and
- Aerial photos, topographic 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 (see figure 3.4-1). The U.S. Department of Transportation, Federal Highway Administration, recognizes the valley for its scenery, and it is designated a national scenic byway. Land use along the corridor of the Connecticut River is primarily rural and agricultural, with considerable land forested and undeveloped. Most of the land along the river is zoned for limited residential use (New Hampshire DES, 2008). There are infrequent commercial and industrial sites. In general, existing developments are well-screened from the river (New Hampshire DES, 2008). Figures 3.11-1, 3.11-2, and 3.11-3 provide examples of the visual character of the Project.

Figure 3.11-1. View downstream of Wilder dam.

Figure 3.11-2. View looking north from the Wilder boat launch.

Figure 3.11-3. Rainbow over impoundment.

The settlement patterns of Europeans in the Connecticut Valley developed a mosaic of villages and small cities surrounded by rural areas. This pattern of development persists in many areas today, and it 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 the state with some of its most valuable scenic views (New Hampshire DES, 2008). 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 Orford. The River Road, north of the East Thetford Bridge to the Orford town line, has been designated a town scenic road.

Agricultural fields and working forestlands juxtaposed to dense villages combine to create the traditional Vermont landscape that residents and tourists cherish (Southern Windsor County RPC, 2009). The Project is located in the fertile soils of the Connecticut River Valley, and 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 and in proximity to the Project along the Vermont shoreline.

Aquatic vegetation can be found in coves and shoal areas along the Wilder reservoir. 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.

Wilder dam and the powerhouse are adjacent to New Hampshire Route 10 and clearly visible to motorists on this road as well as from the scenic picnic overlook across from the dam on the same road. The brick construction of the powerhouse is consistent for historic buildings throughout the Connecticut River Valley as brick is a common building material for the area and era of construction. The duration of the view to motorists on New Hampshire Route 10 is short because only about 0.25 mile of the road parallels the reservoir and dam before turning away from the river at the dam. The fish ladder provides a viewing area to people visiting the dam. Views of the Project are provided at public access points up and down the river as well as the Haverhill-Newbury, Piermont-Bradford, Orford, Lyme-Thetford, and Ledyard (Hanover-Norwich) bridges and select sections of U.S. Interstate 91, U.S. Route 5, and local roads paralleling the river.

3.11.3 Project Effects

The river is a significant landform and integral part of the towns along the river. Operation of the Project is visible from numerous points around the Project. The normal operating range of the Wilder Project is 2.5 feet or less depending upon inflow 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 382.5 feet from Friday at 4 pm through Sunday at midnight during the summer recreation season (May 21 – September 16).

Overall, the reservoir is aesthetically pleasing to view throughout the Connecticut River Valley. 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 2.5-foot change in reservoir elevation is a modest change and likely barely perceptible to the majority of observers in the vicinity of the Project.

TransCanada does not propose any changes to the existing Project. Therefore there would be no incremental 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 National Historic Preservation Act (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 TCP included in, or eligible for inclusion in, the 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 APE in consultation with the appropriate 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 Division for Historic Preservation (Vermont 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

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Historic maps and atlases of towns in the vicinity of the Project were also inspected to assess changes in land use, document structures, and track the development of transportation networks in the vicinity of the Project. As cited in the Phase IA report (Hubbard et al., 2012), historic maps pertinent to the Wilder Project in Vermont included the Blodget (1789), Doolittle (1796), Whitelaw (1796), and Sotzmann (1810) maps of the State of Vermont; the Doton (1856) map of Windsor County; the Walling (1860a) map of the State of Vermont; and the Beers 1869 atlas of Windsor County and the 1877 atlas of Orange County. Historical town maps reviewed for the New Hampshire portion of the Wilder Project include the Holland (1784) map of the Province of New Hampshire; the Walling (1860b) map of Grafton 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 for the relevant sections of New Hampshire and Vermont.

Historic photographs were also inspected. Photographs of Wilder Village (formally known as Olcott Falls) in Hartford, Vermont, depicted images of the early mill dam and the present Wilder dam prior to, during, and after its construction. 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, 2011, as cited by Hubbard et al., 2012). 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).

The Vermont DHP 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 Native American 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 license boundary of the Wilder Project was subject to 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 using 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 28 archaeological sites on flowage lands including river shoreline and 3 sites within fee-owned lands in Vermont; and 16 archaeological sites on flowage lands including river shoreline and 1 site within fee-owned lands in New Hampshire, for a total of 48 identified archaeological sites in the Project APE. Table 3.12-1 summarizes these sites. A total of 23 of the resources are exclusively from the pre-contact period. Three sites contain both pre-contact and historic components, and 21 sites are exclusively from the historic period. The information for one additional site was missing from the Vermont DHP files and is of undetermined age. 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. The historic period resources include historic trash scatters, foundation features, railroad features, abutment features, and other features.

Archival research using eighteenth, nineteenth, and twentieth century town and atlas maps and town historical sources identified 56 locations that might constitute additional archaeological sites. A total of 26 of these locations are potential EuroAmerican sites in Vermont and 28 are potential EuroAmerican sites in New Hampshire. There is also a reputed Native American site (burial ground) in each state, although the one in Vermont appears to be outside the FERC license boundary.

These locations are summarized in table 3.12-2 (Vermont) and table 3.12-3 (New Hampshire). Four of the sites in Vermont correspond to documented archaeological sites (TH-2, NO-6, NO-7, HA-3). The remaining 10 sites in Vermont were not located during the Phase IA survey. In New Hampshire, one site was found to correspond to known archaeological site (LY-1) and one may correspond to an archaeological site (OR-2). The remaining 50 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-GR-112	Haverhill	P	Previously recorded as multiple stratified components; burnt maize, beans, and a large important ceramic assemblage*	Pre-contact (Late Woodland)	Flowage	Undetermined
27-GR-141	Haverhill	P	Previously recorded as a mortar and 80 lb pestle*	Pre-contact (unknown)	Flowage	Undetermined
27-GR-143	Haverhill	P	Previously recorded as human skeletal remains*	Pre-contact (unknown)	Flowage	Undetermined
27-GR-144	Haverhill	PH	*Pre-contact:* Previously recorded as quartz and quartzite chipping debris, soapstone fragments, an adze, and pottery sherds * *Historic:* Previously recorded as historic bridge abutment and central pier. Documentary evidence of a French Fort at location*	Pre-contact (unknown); EuroAmerican (Bridge ca 1805-1979; Fort ca 1704-1761)	Flowage	Undetermined
27-GR-151	Lyme	P	Previously recorded as a campsite, no other information available*	Pre-contact (unknown)	Flowage	Undetermined

State Site Number	Project Vicinity	Site Type[a]	Brief Description[b]	Temporal/ Cultural Affiliation	Location Relative to the Project	National Register Eligibility
27-GR-178	Hanover	P	Previously recorded as pottery sherds and a probable Levanna projectile point*	Pre-contact (Middle-Late Woodland)	Flowage	Undetermined
27-GR-208	Piermont	P	Previously recorded as two probable hearth features containing fire-cracked rock and rhyolite shatter*	Pre-contact (unknown)	Flowage	Undetermined
27-GR-224	Haverhill	P	Previously recorded as three Levanna projectile points and quartz biface fragment*	Pre-contact (Middle-Late Woodland)	Flowage	Undetermined
27-GR-228 (new)	Piermont	P	Lenticular feature with fire-reddened soils and charcoal; probably a hearth	Native American (unknown)	Flowage	Undetermined
27-GR-229 (new)	Orford	P	Two parallel burn layers separated by alluvium with reddish soils, charcoal, and calcined bone. Five pieces of Hornfels chipping debris	Native American (unknown)	Flowage	Undetermined
27-GR-230 (new)	Lyme	H	Both abutments and central pier still standing. Abutment on VT side is concrete while other two elements are mortared stone	EuroAmerican. Originally built in 1896. Closed to traffic in the 1950's. Span collapsed in 1972-1973.	Flowage	Undetermined
27-GR-231 (new)	Lyme	H	Historic trash dump with automobile parts, enamelware, cans, and scrap metal	EuroAmerican (mid-20th century)	Flowage	Undetermined

State Site Number	Project Vicinity	Site Type[a]	Brief Description[b]	Temporal/ Cultural Affiliation	Location Relative to the Project	National Register Eligibility
27-GR-232 (new)	Lyme	P	Seventeen fragments of fire cracked rock	Native American (unknown)	Flowage	Undetermined
27-GR-233 (new)	Hanover	H	Bottles, ceramics, machine-wrought square nails, cans	EuroAmerican (early to mid-20th century)	Fee-owned (Parcel #16)	Undetermined
27-GR-234 (new)	Orford	P	A 15-20 cm deep feature containing orange soils underlain by thin black layer. No artifacts. Not unequivocally cultural, but historic maps call the area the "Indian Burial Ground" (Walling, 1860).	Native American (unknown)	Flowage	Undetermined
27-GR-235 (new)	Lebanon	H	Multiple structures, including a grist and saw mill, canal, paper mill and associated structures, several dams, and a bridge	EuroAmerican (early late 18th to mid-20th century)	Flowage	Undetermined
27-GR-202	Orford	H	Previously recorded as nails, glass, brick, animal bones, ceramics, buttons, pipe stems and bowls, coal and coal slag*	EuroAmerican (Mid-19th century to early 20th century)	Flowage	Undetermined
VT-OR-15	Bradford	P	Previously recorded as surface-collected lithic tools including points, drills, a scraper, and a hoe*	Pre-contact (unknown)	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-OR-18	Newbury	P	Previously recorded as pottery sherds, lithics, charred nuts, and charcoal*	Pre-contact (Early Woodland)	Flowage	Undetermined
VT-OR-19	Newbury	P	Previously recorded as nine hearth features, large assemblage of lithics (including tools and points), pottery, fire cracked rock, and organics*	Pre-contact (Middle-Late Woodland)	Flowage	Undetermined
VT-OR-21	Bradford	P	One chert flake, 1 rhyolite flake*	Pre-contact (unknown)	Flowage	Undetermined
VT-OR-22	Newbury	PH	*Prehistoric:* Previously recorded as one quartzite flake* *Historic:* Previously recorded as unspecified historic artifacts*	Pre-contact (unknown) EuroAmerican (ca 1609-1790);	Flowage	undetermined
VT-OR-34	Fairlee	P	Previously recorded as three chert flakes, one rhyolite flake, 4 fragments of pottery, and 37 pieces of bone*	Pre-contact (Middle Woodland)	Flowage	Potentially eligible
VT-OR-35	Bradford	P	Previously recorded as 37 organic features*	Pre-contact (unknown)	Flowage	Potentially eligible
VT-OR-36	Newbury	H	Unspecified*	EuroAmerican (unknown)	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-OR-38	Fairlee	H	Grist mill with intact walls but no roof*	EuroAmerican (ca 1760-1790)	Flowage	Undetermined
VT-OR-41	Thetford	P	Numerous and diverse lithic assemblage	Pre-contact (unknown)	Flowage	Undetermined
VT-OR-45	Bradford	PH	*Prehistoric:* Previously recorded as three rhyolite flakes, one fragment of fire cracked rock, and a culturally undetermined human burial nearby* *Historic:* Previously recorded as a large assemblage of brick, metal, glass, ceramic, bone, etc.*	Pre-contact (unknown); EuroAmerican (ca 1826-1930's)	Flowage	Undetermined
VT-OR-62	Bradford	P	Previously recorded as a quartz scraper and fire cracked rock*	Pre-contact (unknown)	Flowage	Undetermined
VT-OR-63	Bradford	H	Previously recorded as granite blocks, brick, and ceramic sherds. Possible subsurface evidence of a foundation*	EuroAmerican (unknown)	Flowage	Undetermined
VT-OR-67	Fairlee	P	Previously recorded as one chert flake and possible fire cracked rock*	Pre-contact (unknown)	Flowage	Not eligible

State Site Number	Project Vicinity	Site Type[a]	Brief Description[b]	Temporal/ Cultural Affiliation	Location Relative to the Project	National Register Eligibility
VT-OR-72	Fairlee	H	Previously recorded as a cellar hole with some foundation stones*	EuroAmerican (ca Late 19th Century)	Flowage	Undetermined
VT-OR-95 (new)	Newbury	H	Both abutments and center pier (still standing). The abutment on the Vermont bank consists of dry-laid stone with wooden and cement elements	EuroAmerican (first of 5 bridges at location was built in 1806; most recent bridge 1866-1979)	Flowage	Undetermined
VT-OR-96 (new)	Bradford	H	Automobile parts, appliances, bottles and cans, scrap metal, farm equipment, an unidentified belt-drive assembly which may be related to a nearby historic mill	EuroAmerican (early to mid-20th century)	Flowage	Undetermined
VT-OR-97 (new)	Fairlee	P	Living surface feature with fire cracked rock, a rhyolite biface, and a cow molar found in the slump	Native American (unknown)	Flowage	Undetermined
VT-OR-98 (new)	Fairlee	H	Cans and bottles, enamel cookware, ceramics, etc.	EuroAmerican (mid-20th century)	Flowage	Undetermined
VT-OR-99 (new)	Thetford	H	Cans and bottles, stoneward jugs, automobile parts, scrap metal, etc.	EuroAmerican (early to mid-20th century)	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-OR-100 (new)	Thetford	H	Both abutments and the center pier are still standing. Both of the elements in NH are mortared stone, the VT abutment is made of concrete	EuroAmerican (Built in 1896; closed to traffic in the 1950's; destroyed in 1972-1973)	Flowage	Undetermined
VT-OR-101 (new)	Thetford	H	Early machine-made bottles, flat iron trivet, bronze/copper kerosene lamp, ceramics	EuroAmerican (early 20th century)	Flowage	Undetermined
VT-OR-102 (new)	Thetford	H	Automobiles, tires, appliances	EuroAmerican (mid-20th century)	Flowage	Undetermined
VT-WN-237	Gleason	H	Previously recorded as the buried remains of two or more structures related to a previous building on this spot*	EuroAmerican (late 19th century)	Flowage	Undetermined
VT-WN-477 (new)	Norwich	H	Bridge abutments. Both abutments extant. Dry-laid stone with cement elements	EuroAmerican (first of several bridges at location built in either 1771 or 1787. Latest bridge from 1866-1954)	Flowage	Undetermined
VT-WN-478 (new)	Norwich	H	Dry-laid foundation wall and associated wooden shed (left bank) and corresponding L-shaped cement wall projecting into river (right bank)	EuroAmerican (early to mid-19th century)	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-479 (new)	Hartford	P	Hearth feature, chipping debris (rhyolite, hornfels, chert), one hornfels biface, and calcined bone	Native American (unknown)	Fee-owned/flowage	Undetermined
VT-WN-480 (new)	Hartford	H	Multiple structures including a paper mill and associated structures, several dams and dam improvements, and a bridge	EuroAmerican (Late 18th to mid-20th century)	Fee-owned/flowage	Undetermined
VT-WN-481 (new)	Hartford	H	Bottle glass, ceramics, and metal fragments	EuroAmerican (early to mid-19th century)	Fee-owned/flowage	Undetermined
F.S. 3 (OR)	Bradford	P	Previously recorded as "some" projectile points located in "Indian mounds" *	Pre-contact (unknown)	Flowage	Undetermined
F.S. 21 (WN)	Norwich	U	Unknown (files missing at VTDHP) *	Unknown	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 Wilder shoreline study area identified on historic maps (Vermont)

ID Number	Description	Identification on Historic Maps					Notes
		Doolittle (1796)	Beers (1869; 1877)	USGS (1931)	USGS (1933)	Other USGS	
NE-1	Toll house		(1877) appears as Toll Ho.			(1935, 1941)	Identified as standing architecture
BR-1	Dwelling or mill?		(1877) may appear as mill			X (1935, 1941)	
BR-2	Dwelling		(1877) appears as E. Smalley		(1933)		
FA-1	Ferry launch	X	(1877)				
TH-1	Ferry launch	X	(1877)				
TH-2	Bridge		(1877)	Appears in use	Appears in use		Located (VT-OR-100)
TH-3	Ferry launch	X	(1877)				
TH-4	Ferry launch	X	(1877)				
TH-5	Toll house		(1877) appears as Toll H.				

ID Number	Description	Identification on Historic Maps					Notes
		Doolittle (1796)	Beers (1869; 1877)	USGS (1931)	USGS (1933)	Other USGS	
TH-6	Dwelling		(1877) appears as C.D. Dimick				
TH-7	Bridge		(1877) roads end at bank indicating possible bridge location				
NO-1	Ferry launch	X	(1869)				
NO-2	Ferry launch	X	(1969)			(1906, 1908)	
NO-3	Dwelling		(1969) appears as D. Huckett			(1906, 1908)	
NO-4	Ferry launch	X	(1869)			(1906, 1908)	
NO-5	Bridge	X	(1869)			(1906, 1908)	
NO-6	Bridge		(1869) appears in use			(1906, 1908) appears in	Located (VT-WN-477)

ID Number	Description	Identification on Historic Maps					Notes
		Doolittle (1796)	Beers (1869; 1877)	USGS (1931)	USGS (1933)	Other USGS	
						use	
NO-7	Saw mill		(1869) appears as S. Mill			(1906, 1908)	Located (VT-WN-478)
NO-8	Dwelling		(1869) appears as M. Bartlett			X (1906, 1908)	
NO-9	Grist mill		(1869) appears S G. Mill			X (1906, 1908)	
NO-10	Native American burial ground		(1869)				Goddard and Partridge (1905); J. Moody (pers. comm.)
NO-11	Dwelling		(1869)			(1906, 1908)	First settlement (1765); based on historical marker
NO-12	Bridge		(1869) appears with road			(1906, 1908) replaced with steel truss bridge	

ID Number	Description	Identification on Historic Maps					Notes
		Doolittle (1796)	Beers (1869; 1877)	USGS (1931)	USGS (1933)	Other USGS	
NO-13	Ferry launch		(1869)				Goddard and Partridge (1905)
HA-1	Saw mill		(1869)			(1906, 1908)	Whitelaw (1769) appears as Phelps Saw Mill
HA-2	Bridge		(1869)			X (1906, 1908)	
HA-3	Paper mill		(1869) appears French as Chandler Paper Mill			X (1906, 1908)	Located (VT-WN-480)

Table 3.12-3. Post-contact sites within the Wilder shoreline study area identified on historic maps (New Hampshire)

ID Number	Description	Identification on Historic Maps						Notes
		Walling (1860)	USGS (1931)	USGS (1933)	Other USGS	Hurd (1892)	Holland (1784)	
HA-1	Dwelling				X (1935, 1941, 1984)			
HA-2	Dwelling				X (1935, 1941)			Cellar hole identified outside project area
HA-3	Toll house	Appears as Toll House			X (1935, 1941)	Appears as Toll House		Identified as standing architecture
OR-1	Dwelling	Appears as First Settlement						
OR-2	Native American burial ground	Appears as Indian Burial Ground						Possibly identified (27-GR-234)
LY-1	Bridge	Appears in use as Lime Bridge	Appears in use	Appears in use		Appears in use as Lime		Located (27-GR-230)
LY-2	Toll house	Appears as						

ID Number	Description	Identification on Historic Maps						Notes
		Walling (1860)	USGS (1931)	USGS (1933)	Other USGS	Hurd (1892)	Holland (1784)	
		Toll House						
LY-3	Dwellings (3)	One appears as J. Butler, other two unnamed						
LY-4	Toll house and ferry launch	Appears as Toll House	Appears (toll house only)	Appears (toll house only)		Appears as Toll House		Beers (1877) appears as Toll Ho.; ferry in Doolittle (1796)
LY-5	Dwelling		X	X				
LY-6	Bridge	X				Appears as Thetford Bridge		Beers (1877)
LY-7	Ferry launch							Doolittle (1796)
LY-8	Ferry launch							Doolittle (1796)
HN-1	Dwelling	Appears Dr. Smalley						
HN-2	Dwelling	Appears as I. & H.B. Lord						

ID Number	Description	Identification on Historic Maps						Notes
		Walling (1860)	USGS (1931)	USGS (1933)	Other USGS	Hurd (1892)	Holland (1784)	
HN-3	Dwelling	Appears as J. Hemenway			(USGS 1906, 1908)			
HN-4	Dwelling	Appears as E.S. Coswell			(USGS 1906, 1908)			
HN-5	Bridge				(USGS 1906, 1908)			Doolittle (1796)
HN-6	Ferry launch				(USGS 1906, 1908)			Doolittle (1796)
HN-7	Ferry launch				(USGS 1906, 1908)			Doolittle (1796)
HN-8	Ferry launch				(USGS 1906, 1908)			Doolittle (1796)
HN-9	Ferry launch				(USGS 1906, 1908)			Doolittle (1796)
HN-10	Dwelling				X (USGS 1981, 1989,			Dartmouth Outing Club (2012)

ID Number	Description	Identification on Historic Maps						Notes
		Walling (1860)	USGS (1931)	USGS (1933)	Other USGS	Hurd (1892)	Holland (1784)	
					2001)			
LE-1	Bridge	X			X (USGS 1906, 1908)			
LE-2	Mills (2)	Appears as White River Falls Carp Mills			(USGS 1906, 1908)			
LE-3	Saw mill	Appears as saw mill			(USGS 1906, 1908)			
LE-4	Dwellings (7)				X (USGS 1906, 1908)			
LE-5	Mill				X (USGS 1906, 1908)	Appears as Olcott Falls Pulp Co.		
LE-6	Canal				(USGS 1906, 1908)			Hayes (1929)

Historic Hydroelectric System Features

In 1882, the Olcott Falls Company, locally known as the Wilder Paper Mill, was formed by brothers Charles and Herbert Wilder who were successful paper merchants from Boston (Hubbard et al., 2012). The brothers purchased mill privileges on both sides of the river at Olcott Falls, and by 1883, had constructed a new timber crib dam across the upper falls to supply located mills on both sides of the river with water and power for the processing of pulp and the manufacturing of paper.

In 1899, the paper mill was sold to the International Paper Company, which operated a large paper mill in Bellows Falls, Rockingham, Vermont (Hubbard et al., 2012). The International Paper Company expanded the mill operations between 1905 and 1907, and added two generator units in 1910 and 1912.

The next major change was in 1926, when a concrete dam was constructed just downstream from the 1882 dam. In 1928, a second grinder line was converted to a generating unit. The mill ceased operations in 1927 and most of the mill buildings were razed by 1937. In 1937 and 1938, the original waterwheel units were rehabilitated and a generator was installed on one more grinder line.

On November 6, 1942, Bellows Falls Hydro-Electric Corporation purchased the Wilder Project from Olcott Falls Company as it then existed. FERC issued a license for the Project on April 22, 1944, and on July 28, 1948, the license was transferred to New England Power Company. The modern Wilder dam and powerhouse was built at the Lower Falls on the river between1947 and 1950. Two major construction projects consisting of a fishway installation and the addition of a third generating unit were completed in 1987. Both the powerhouse and dam have been assessed as potentially eligible for listing on the National Register but have not been formally evaluated in consultation with the SHPOs.

The late nineteenth-century Wilder Village that supported the earlier mill survives today in the town of Hartford, Vermont, between Route 5 (Hartford Avenue) and Passumpsic Avenue just east of the railroad easement (Hubbard et al., 2012). The Wilder Village Historic District was listed on the National Register in November 1999 (Hartford Historic Preservation Commission, 2012, as cited by Hubbard et al., 2012). The district is located outside of the Wilder Project fee-owned lands. The majority of the mill site was submerged by the impoundment created by the Wilder dam. Only a few structures related to the mill site are visible today, and they are included in the newly designated Olcott Falls Industrial Complex Site (VT-WN-480).

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, there are two non-recognized tribes: the Abenaki Nation of New Hampshire and the Penacook New Hampshire Tribe.

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 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 Wilder 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. and 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.[8]

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 NHPAct in 1992 (§101(d)(6)(A)) specify that TCPs claimed by a tribe may be determined eligible for inclusion in the National Register. No TCPs that are eligible for listing on the National Register have been identified within the Project APE.

Of the 48 archaeological resources in the study area, two are potentially eligible for listing (VT-OR-34; VT-OR-35) and one is ineligible (VT-OR-67). The National Register eligibility of the remaining 45 documented resources within the APE has not been determined.

The Wilder Hydroelectric Project meets the age criterion for listing on the National Register but has not been formally evaluated. However, it has been managed by TransCanada as eligible. The Wilder Village Historic District is not located within the Project APE.

3.12.5 Project Effects

Archaeological and Historic-era Resources

The Phase IA archaeological field investigations observed erosion along the Project impoundment shoreline and immediately below Wilder dam, 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. Three of the six newly identified pre-contact sites documented during the course of the survey were found in eroding banks below

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[8] Emphasis added.

cultivated fields while two others were on steep slopes in close proximity to the railroad easement.

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). 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 in Haverhill, New Hampshire, attempts by private landowners to comply with the provisions of the 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 or prioritize the sites within the Wilder APE 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 any 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 Wilder Project hydroelectric system components meet the age criterion for potential National Register eligibility and were recommended as potentially eligible during the systemwide assessment of standing hydroelectric structures (Doherty and Kierstead, 1999, as cited by Hubbard et al., 2012), but no formal determination was made through consultation with the SHPOs. Throughout the term of any new license, activities such as maintenance, repair, alteration, replacement, and new construction may be necessary. To retain the historic integrity of the system, formal National Register evaluation of the Wilder Project system would be required, and if determined to be eligible for listing, the HPMP would specify that any major repairs or modifications to eligible elements would 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 any National Register-eligible structures would be done using 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.

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)

Hubbard, M., S. Cherau, J. Elam, J. Daly, and O. 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.

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.

USDA (U.S. Department of Agriculture). 2011. *Custom Soil Resource Report for Windsor County, Vermont.* United States Department of Agriculture, Natural Resources Conservation Service. Electronic document generated from Natural Resources Conservation Service Web Soil Survey. Available at http://www.websoilsurvey.nrcs.usda.gov. (Accessed November 15, 2011). (not seen, as cited in Hubbard et al., 2012).

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).

Vermont ANR (Vermont Agency for Natural Resources). 1998. Values of Riparian Buffers. Retrieved January 12, 2012 from ttp://www.anr.state.vt.us/dec/waterq/rivers/docs/rv_riparianvalues.pdf.

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 Hartford, Norwich, Thetford, Fairlee, and Bradford are located in Vermont, from south to north along the river, within proximity to the Project. The communities of Lebanon, Hanover, Lyme, Orford, Piermont, and Haverhill are located in New Hampshire, from south to north to the river, within proximity to the Project.

3.13.2 Summary of Existing Studies

To describe the socioeconomic resources of the Project vicinity, which includes Windsor and Orange counties in Vermont and Grafton County in New Hampshire, we consulted records of the U.S. Census Bureau and gathered information from relevant plans by Regional Planning Commissions, including the Southern Windsor County Planning Commission Regional Plan (2009) and the Two Rivers-Ottauquechee Regional Plan (2007).

3.13.3 Land Use Patterns

The majority of the landscape in Winsor and Orange counties in Vermont and Grafton County in New Hampshire is forested and rural. Many agricultural lands are located in the fertile Connecticut River Valley. Although the land devoted to farming has decreased steadily in this region, agriculture and forestry have defined the character and identity of Vermont and New Hampshire (Two Rivers-Ottauquechee Planning Commission, 2007). The regional socioeconomic centers include the business districts of Windsor and Hartford in Vermont, and Lebanon and Hanover in New Hampshire (Southern Windsor County Planning Commission, 2009).

3.13.4 Population Patterns

The three counties are relatively rural, with population densities lower than that of the states of Vermont and New Hampshire overall. Population has increased across Grafton and Orange counties between 1990 and 2010, although Windsor County, Vermont has experienced a slight decrease in population between 2000 and 2010. These figures are summarized in table 3.13-1.

Table 3.13-1. Population trends in the Project vicinity (Source: U.S. Census, 2010a).

State and County	1990	2000	2010	Percent Change 1990-2000	Percent change 2000-2010
Grafton County, NH	74,929	81,743	89,118	9%	9%
New Hampshire	*1,109,252*	*1,235,786*	*1,316,470*	*11%*	*7%*
Orange County, VT	26,149	28,226	28,936	8%	3%
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 when compared to their respective state populations.

Table 3.13-2. 2010 Demographic statistics for counties in the Project vicinity (Source: U.S. Census, 2010a).

Demographic Indicator	Orange County	Windsor County	Vermont	Grafton County	New Hampshire
Geography and Population					
Population	28,936	56,670	625,741	89,118	1,316,470
Area (Square Miles)	687	969	9,217	1,709	8,953
Population Density (persons per square mile)	42	58	67	52	147

Demographic Indicator	Orange County	Windsor County	Vermont	Grafton County	New Hampshire
Gender					
Male	49.8%	49.0%	49.3%	49.5%	49.3%
Female	50.2%	51.0%	50.7%	50.5%	50.7%
Age					
Persons under 5 years old	5.1%	4.7%	5.1%	4.6%	2.7%
Persons under 18 years old	20.9%	19.9%	20.7%	18.4%	21.8%
Persons 18 to 64 years old	64.3%	62.3%	64.7%	66.1%	64.7%
Persons 65 years old and over	14.8%	17.8%	14.6%	15.5%	13.5%
Race					
White	97.0%	96.3%	95.3%	93.6%	93.9%
Black	0.4%	0.6%	1.0%	0.9%	1.1%
American Indian and Alaska Native	0.3%	0.3%	0.4%	0.4%	0.2%
Asian	0.5%	0.9%	1.3%	3.0%	2.2%
Hispanic or Latin (for any race)	1.0%	1.2%	1.5%	1.8%	2.8%
Two or More Races	1.5%	1.7%	1.7%	1.8%	1.6%
Households					
Number of Households	11,887	24,753	256,442	35,986	518,973
Average Size of Households	2.37	2.25	2.34	2.28	2.46

Table 3.13-3 summarizes smaller cities and towns and their associated populations located adjacent to the Project. Wilder dam and the majority of the powerhouse structure including two of the three generating units are in Lebanon, New Hampshire, while the remaining generating unit and powerhouse is located in

Hartford, Vermont. The towns of Hanover, New Hampshire, and Norwich, Vermont, located 3 miles north of the powerhouse, are the closest upstream communities to the Project.

Table 3.13-3. Population of cities and towns adjacent to the Project (Source: U.S. Census, 2010a).

County and State	Cities and Towns	2010 Population
Orange County, VT	Fairlee	977
	Bradford	2,797
	Thetford	2,588
Windsor County, VT	Norwich	3,414
	Newbury	2,216
	Hartford	9,952
Grafton County, NH	Hanover	11,260
	Haverhill	4,697
	Lyme	1,716
	Lebanon	13,151
	Orford	1,237
	Piermont	790

3.13.5 Employment and Labor Force

Unemployment rates in the study area counties are less than or equal to those in their respective states. Median household income is more than $10,000 less in Grafton County, New Hampshire when compared to New Hampshire's median household income. Median household income in Orange and Windsor counties are about the same as median household income across Vermont. These figures are summarized in table 3.13-4.

Table 3.13-4. 2010 County and state labor force and income (Source: U.S. Census, 2010b).

Labor Force and Income	Grafton, NH	New Hampshire	Orange, VT	Windsor, VT	Vermont
Civilian Labor Force	48,326	745,784	16,286	31,191	351,795
Employed	45,760	696,250	15,095	29,229	328,350
Unemployed	2,566	49,534	1,191	1,962	23,445
Percent Unemployed	5%	7%	7%	6%	7%
Median Household Income (2010$)	$51,025	$61,989	$51,028	$51,229	$51,605

Employment by industry is summarized in table 3.13-5. Across the study area counties, educational services and healthcare and social assistance account for between 27 and 34 percent. Other important industries in the counties include retail trade; manufacturing; construction; and professional, scientific, management and administrative and waste management services. Additionally, in Orange County, agriculture, forestry, and mining account for almost 6 percent of the workforce in the county.

Table 3.13-5. 2010 Employment by industry in Project counties (Source: U.S. Census, 2010b).

Industry	Grafton, NH	New Hampshire	Orange, VT	Windsor, VT	Vermont
Civilian employed population 16 years and over	45,760	696,250	15,095	29,229	328,350
Agriculture, forestry, fishing and hunting, and mining	1.9%	0.8%	5.5%	2.3%	2.7%
Construction	8.2%	7.2%	9.3%	9.1%	7.5%
Manufacturing	8.8%	13.0%	9.2%	9.3%	10.4%
Wholesale trade	1.3%	3.0%	3.1%	2.4%	2.6%
Retail trade	13.1%	13.1%	12.6%	10.7%	12.0%

Industry	Grafton, NH	New Hampshire	Orange, VT	Windsor, VT	Vermont
Transportation and warehousing, and utilities	2.4%	3.8%	3.0%	3.8%	3.5%
Information	1.2%	2.2%	1.2%	2.2%	2.0%
Finance and insurance, and real estate and rental and leasing	3.9%	6.7%	4.3%	4.8%	4.8%
Professional, scientific, and management, and administrative and waste management services	7.6%	10.1%	8.2%	9.4%	8.9%
Educational services, and health care and social assistance	34.1%	23.8%	28.9%	26.6%	27.2%
Arts, entertainment, and recreation, and accommodation and food services	11.1%	8.1%	5.3%	10.6%	9.2%
Other services, except public administration	3.4%	4.3%	4.0%	4.3%	4.4%
Public administration	3.0%	3.8%	5.4%	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 nonprofit 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

Southern Windsor County 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).

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.

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.

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3.14 TRIBAL RESOURCES

3.14.1 Summary of Existing Studies

The following websites were checked to obtain information about tribes in Vermont and New Hampshire who may have resource interests in the Project area:

- 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
- 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 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 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 tribe and the Nulhegan Band of Coosuk Abenaki as State-recognized tribes. 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 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. 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) provide studies or initiatives that would assist in the evaluation of resources and Project impacts. The following list represents the studies and initiatives undertaken in advance of drafting the PAD and their current status:

- GIS/Digital project maps – under development
- Lower Connecticut River Project Shoreline Survey and Mapping - completed; report pending
- 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; report pending
- 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 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. We solicited comments or concerns at each of those meeting 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. Erosion specific surveys have not be performed post Tropical Storm Irene except for the Phase 1A investigations which occurred very shortly thereafter. The Phase 1A investigation found recent, presumably Irene related, erosion 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.

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.

Wilder 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 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 could be enhanced.

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 under review 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

Wilder 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 2.5 feet at Wilder 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.

TransCanada conducted mussel surveys at the Project in 2011 that identified three mussel species downstream of the Wilder dam and five 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 approximately 2.5-foot normal 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 Wilder include migratory birds, and most local wildlife.

Shoreline botanical resources are impacted within the 2.5-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 2.5-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.

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 35 RTE species, including the federally listed dwarf wedgemussel. Project operations have the potential to affect RTE species that occur within the influence of the river. Plants, which comprise 30 of the 35 listed species, may be adversely affected by erosion and scour, as well as fluctuating water levels.

4.7.2 Proposed Studies

TransCanada conducted mussel surveys at the Project in 2011 that identified three mussel species downstream of the Wilder dam and five species in the reservoir, including the dwarf wedgemussel. Threats to dwarf wedgemussel include stranding from water level fluctuations, water quality degradation, sedimentation, erosion, and river channel alteration.

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 Bellows Falls Project impoundment. TransCanada consulted with FWS, the New Hampshire NHB and the Vermont NHIP 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. As discussed in section 3.9.4, this species does not occur within the Wilder RTE project area, but does occur in downstream locations that could be affected by Wilder Project operations.

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 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.

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 seven 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 ten 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 and station discharge 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 (Hubbard et al., 2012) 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, including fee owned parcels that border the Connecticut, Waits, and Ompompanoosuc Rivers and their impoundment areas for project for project effects to archaeological sites and sensitive areas identified within the FERC license boundary during the Phase IA archaeological survey. Should identified impacts to 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.

The Project has been assessed as potentially eligible for listing on the National Register but has not been formally evaluated in consultation with the SHPOs.

Formal evaluation of the system and its components would allow for appropriate management to be determined and addressed in the proposed HPMP.

4.10.2 Proposed Studies

In consultation with Vermont and New Hampshire 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.

The Project has not yet been formally evaluated for listing on the National Register in consultation of the SHPOs. Evaluation of the hydroelectric system will be completed prior to issuance of the Final License Application. If the system is determined to be eligible, potential effects will be addressed in the HPMP. The results of these studies would be used to develop a Project HPMP.

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 the New Hampshire SHPO, and eventually to the Commission. The PA will call for the development/implementation of a Historic Properties Management Plan (HPMP) that will 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. section 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. section 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 Wilder 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.

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) Wantastiquest 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) Wantastiquest 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

The following list includes additional relevant resource management plans not included in the list of Comprehensive Plans in section 4.3 above.

New Hampshire

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.

Basin 14 – “Little Rivers” Water Quality Management Plan covering the Stevens, Wells, Waits, and Ompompanoosuc River Watersheds. Vermont Agency of Natural Resources. 2008.

Southern Windsor County Regional Plan. Southern Windsor County Regional Planning Commission. 2009.

Two Rivers-Ottauquechee Regional Plan. Two Rivers-Ottauquechee Regional Commission. 2012.

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.

White River Basin Plan - A Water Quality Management Plan. Vermont Agency of Natural Resources. 2002.

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, and 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 and 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, Conservation 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. 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 Department of Fish and 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 48 individuals (excluding TransCanada representatives) attended the Wilder site visit. In addition to 11 members of the public, including local residents, representatives of downstream Connecticut River hydroelectric projects, and the media, 16 organizations were represented at the site visit (table 5.2-3).

Table 5.2-3. Organizations represented at the FERC site visit.

American Rivers
Audubon Society of New Hampshire
City of Lebanon 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
The Nature Conservancy
Trout Unlimited
U.S. Fish and Wildlife Service
Upper Valley Lake Sunapee Regional Planning Commission
Vermont Institute of Natural Science
VT Department of Environmental Conservation
VT Department of Fish and Wildlife

ATTACHMENT 1

PROJECT BOUNDARY MAPS

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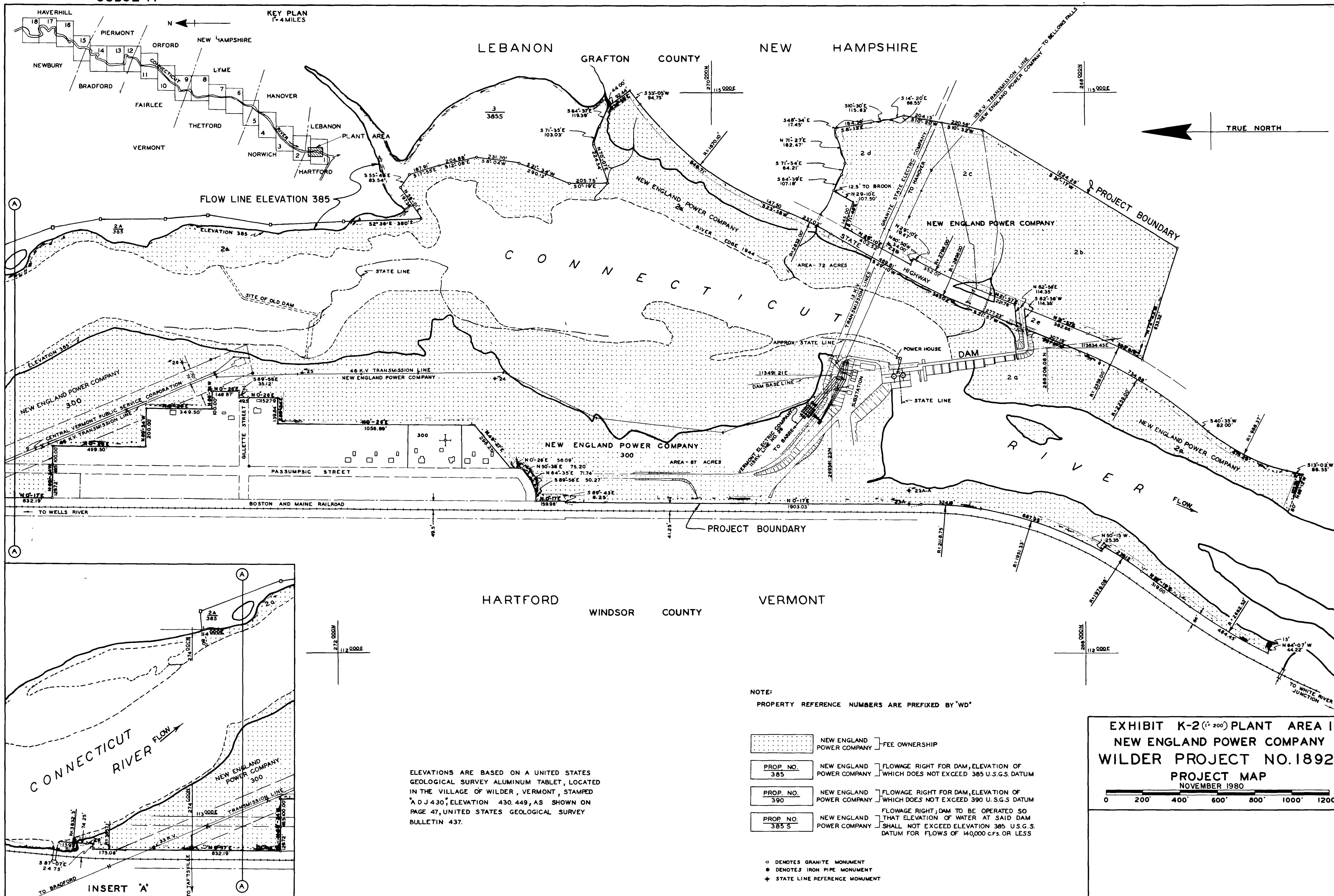


NOTE:
PROPERTY REFERENCE NUMBERS ARE PREFIXED BY "WD"

ELEVATIONS ARE BASED ON A UNITED STATES GEOLOGICAL SURVEY ALUMINUM TABLET, LOCATED IN THE VILLAGE OF WILDER, VERMONT, STAMPED "A D J 430", ELEVATION 430.449, AS SHOWN ON PAGE 47, UNITED STATES GEOLOGICAL SURVEY BULLETIN 437.

(dotted)	NEW ENGLAND POWER COMPANY	FEE OWNERSHIP
PROP. NO. 385	NEW ENGLAND POWER COMPANY	FLOWAGE RIGHT FOR DAM, ELEVATION OF WHICH DOES NOT EXCEED 385 U.S.G.S. DATUM
PROP. NO. 390	NEW ENGLAND POWER COMPANY	FLOWAGE RIGHT FOR DAM, ELEVATION OF WHICH DOES NOT EXCEED 390 U.S.G.S. DATUM
PROP. NO. 385 S	NEW ENGLAND POWER COMPANY	FLOWAGE RIGHT; DAM TO BE OPERATED SO THAT ELEVATION OF WATER AT SAID DAM SHALL NOT EXCEED ELEVATION 385 U.S.G.S. DATUM FOR FLOWS OF 140,000 C.F.S. OR LESS

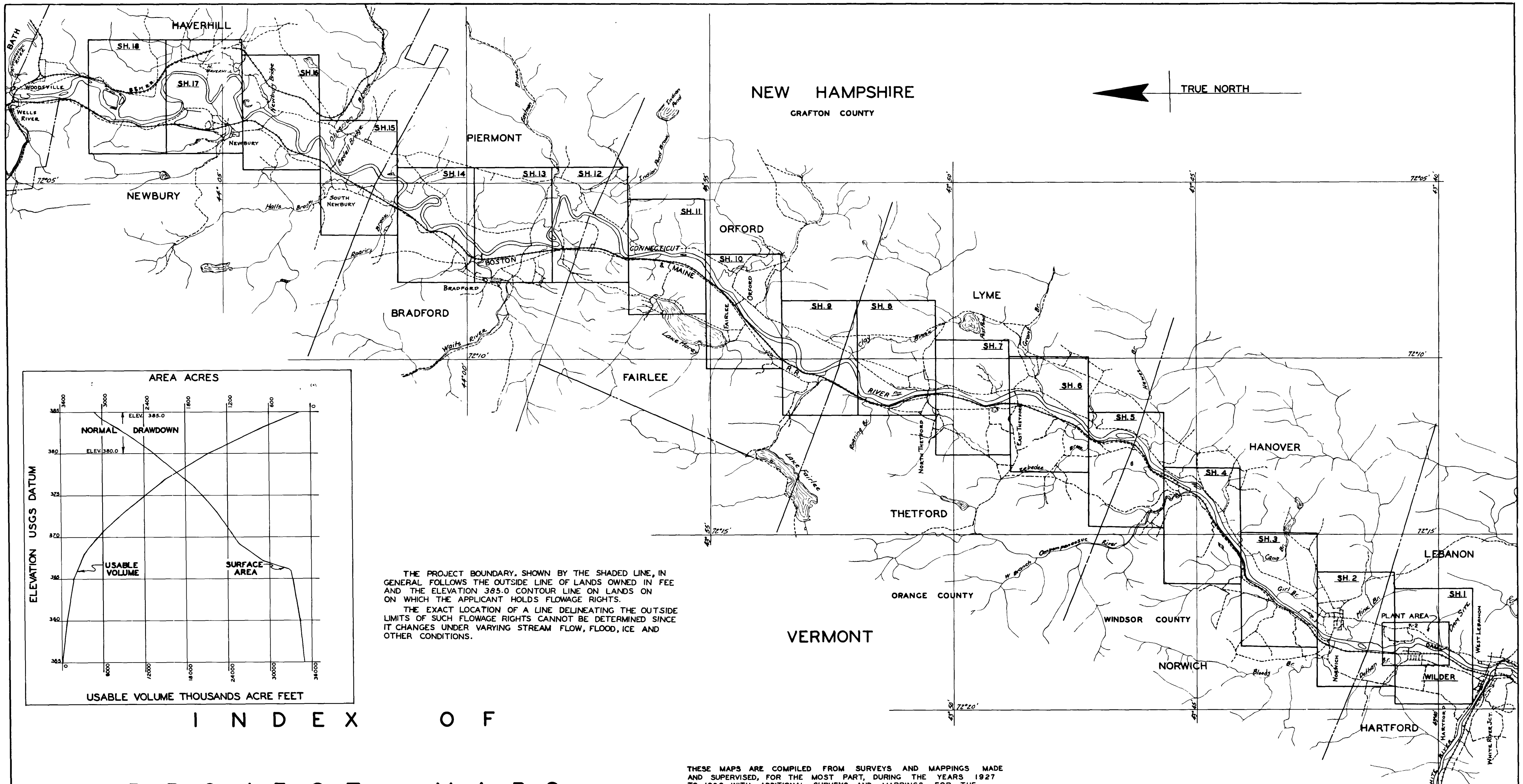
○ DENOTES GRANITE MONUMENT
● DENOTES IRON PIPE MONUMENT
✦ STATE LINE REFERENCE MONUMENT

EXHIBIT K-2 (1" = 200') PLANT AREA IB
NEW ENGLAND POWER COMPANY
WILDER PROJECT NO. 1892
PROJECT MAP
NOVEMBER 1980
0 200' 400' 600' 800' 1000' 1200'

FERC 1892-108 H-36520

MICROFILM OF THESE ORIGINAL DRAWINGS FILED WITH FERC 11/24/80

H-36521



THE PROJECT BOUNDARY, SHOWN BY THE SHADED LINE, IN GENERAL FOLLOWS THE OUTSIDE LINE OF LANDS OWNED IN FEE AND THE ELEVATION 385.0 CONTOUR LINE ON LANDS ON ON WHICH THE APPLICANT HOLDS FLOWAGE RIGHTS.

THE EXACT LOCATION OF A LINE DELINEATING THE OUTSIDE LIMITS OF SUCH FLOWAGE RIGHTS CANNOT BE DETERMINED SINCE IT CHANGES UNDER VARYING STREAM FLOW, FLOOD, ICE AND OTHER CONDITIONS.

INDEX OF PROJECT MAPS

TRACED FROM U.S.G. SURVEY MAPS
HANOVER, MASCOMA, STRAFFORD, MT. CUBE AND WOODSVILLE QUADRANGLES

SCALE = $\frac{1}{62500}$

ELEVATIONS ARE BASED ON A UNITED STATES GEOLOGICAL SURVEY ALUMINUM TABLET, LOCATED IN THE VILLAGE OF WILDER, VERMONT, STAMPED "ADJ 430", ELEVATION 430.449, AS SHOWN ON PAGE 47, UNITED STATES GEOLOGICAL SURVEY BULLETIN 437.
SEE EXHIBIT K-1 FOR DESCRIPTION OF PROJECT BOUNDARY

THESE MAPS ARE COMPILED FROM SURVEYS AND MAPPINGS MADE AND SUPERVISED, FOR THE MOST PART, DURING THE YEARS 1927 TO 1932, WITH ADDITIONAL SURVEYS AND MAPPINGS FOR THE REDEVELOPMENT MADE DURING THE YEARS 1941 TO 1950, BY COMPANY EMPLOYEES WHO ARE NOW RETIRED OR DECEASED. RECOGNIZED STADIA METHODS WERE USED EXCEPT WHERE GREATER ACCURACY WAS REQUIRED.

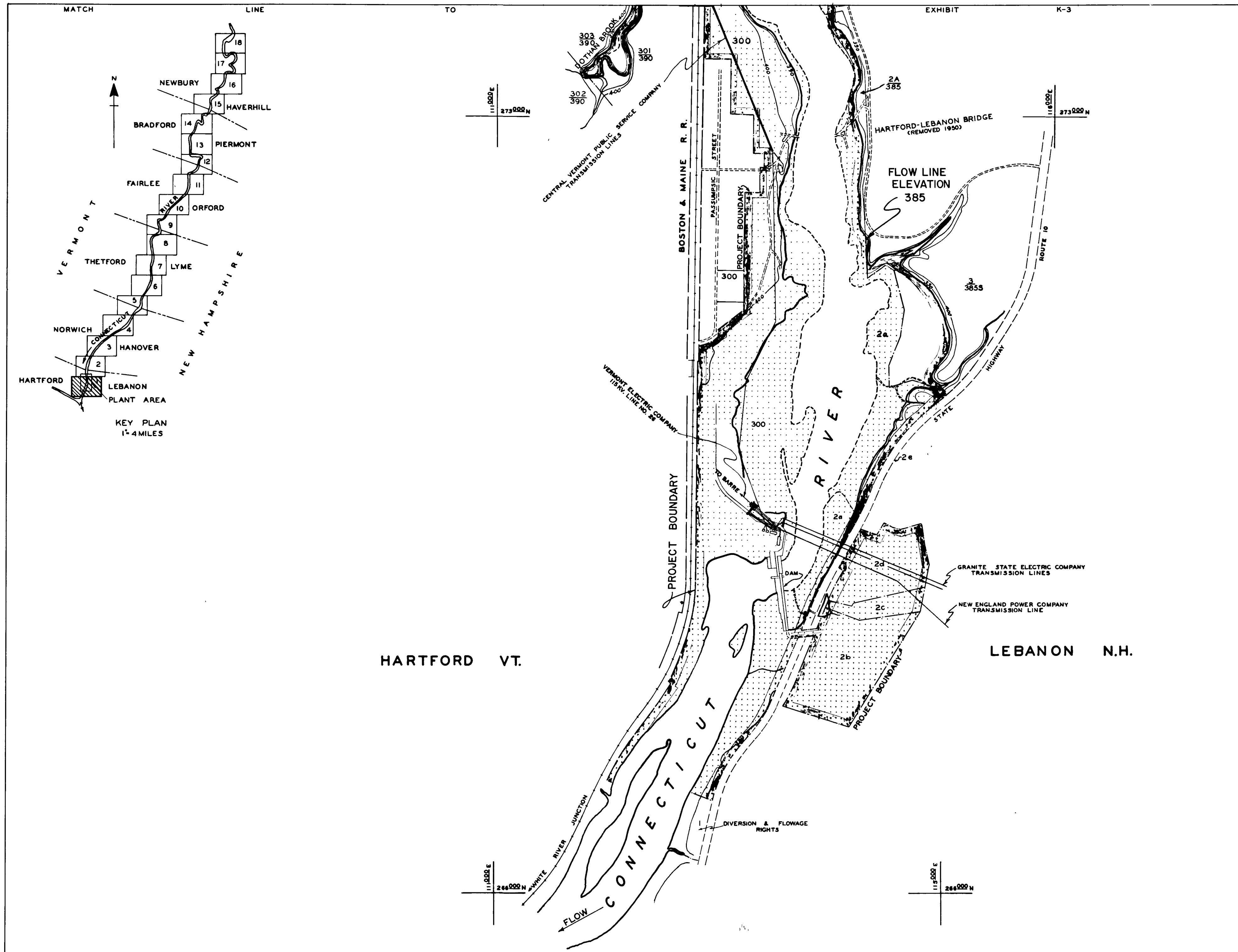
Ogden E. Sawyer VICE PRESIDENT

EXHIBIT K-3	INDEX 1B
NEW ENGLAND POWER COMPANY	
WILDER PROJECT NO. 1892	
PROJECT MAP	
NOVEMBER 1980	
0 5000 10000 20000 30000 Ft.	

MICROFILM OF THESE ORIGINAL DRAWINGS FILED WITH FERC 11/24/80

FERC 1892-109 H-36521

MATCH LINE TO EXHIBIT K-3 SHEET — 2B OF 18

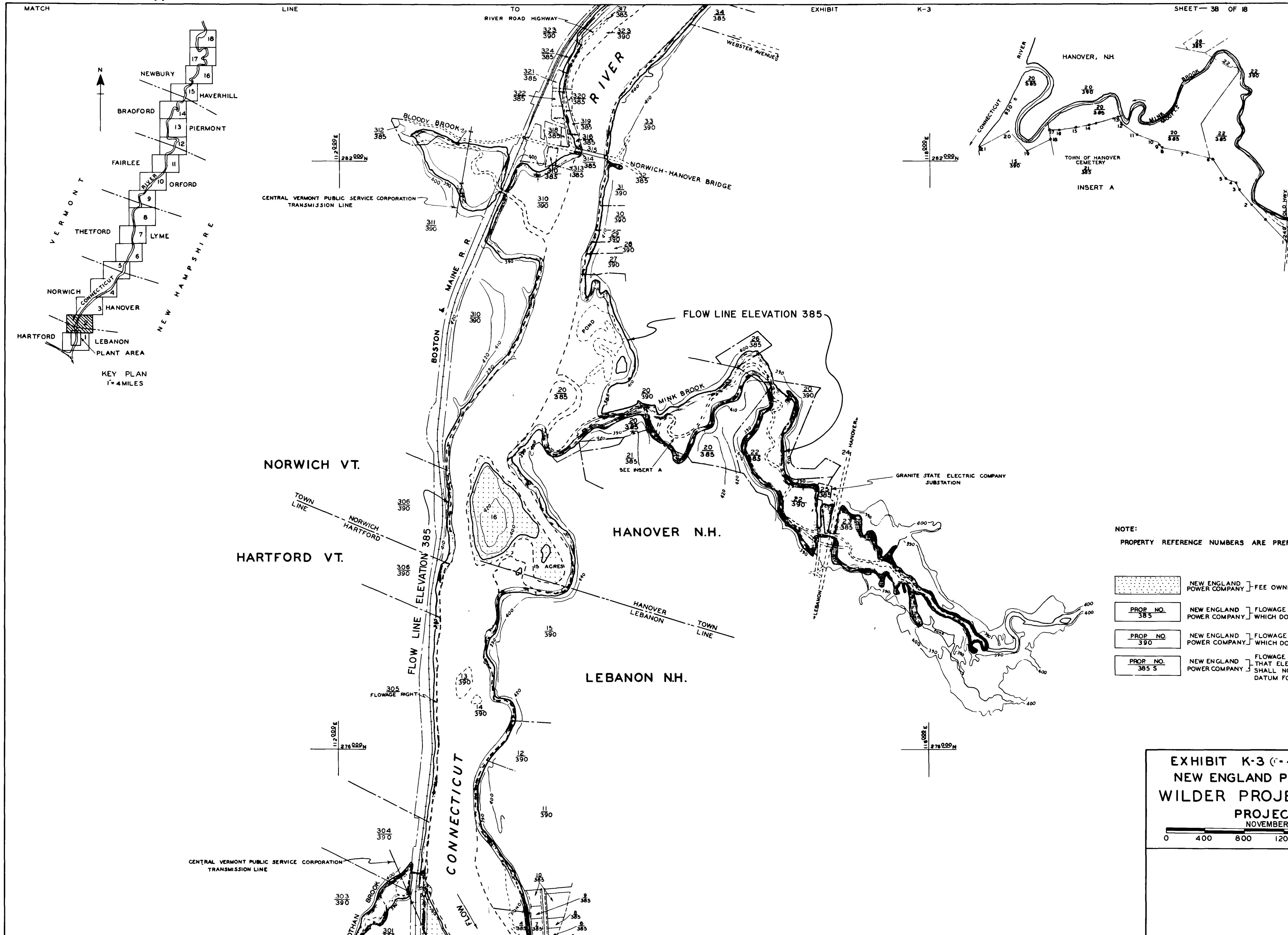


NOTE:
PROPERTY REFERENCE NUMBERS ARE PREFIXED BY "WD"

(stippled)	NEW ENGLAND POWER COMPANY	FEE OWNERSHIP
PROP NO 385	NEW ENGLAND POWER COMPANY	FLOWAGE RIGHT FOR DAM, ELEVATION OF WHICH DOES NOT EXCEED 385 U.S.G.S. DATUM
PROP NO 390	NEW ENGLAND POWER COMPANY	FLOWAGE RIGHT FOR DAM, ELEVATION OF WHICH DOES NOT EXCEED 390 U.S.G.S. DATUM
PROP NO 385S	NEW ENGLAND POWER COMPANY	FLOWAGE RIGHT; DAM TO BE OPERATED SO THAT ELEVATION OF WATER AT SAID DAM SHALL NOT EXCEED ELEVATION 385 U.S.G.S. DATUM FOR FLOWS OF 140,000 CFS OR LESS

EXHIBIT K-3 (1"=400') SHEET 1B OF 18
NEW ENGLAND POWER COMPANY
WILDER PROJECT NO. 1892
PROJECT MAP
NOVEMBER 1980

0 400 800 1200 1600 2000 2400 FT.



	STATION	BEARING	DISTANCE
	1	N 42°-00'W	530.4
	2	N 37°-57'W	203.50
	3	N 19°-01'W	69.03
	4	N 89°-49'W	118.89
	5	N 35°-13'W	233.20
	6	N 73°-09'W	255.65
	7	N 80°-22'W	265.34
	8	N 30°-27'W	45.55
	9	N 8°-16'W	28.10
	10	N 70°-30'W	230.89
	11	N 51°-27'W	209.30
	12	N 31°-53'W	78.45
	13	S 74°-22'W	284.90
	14	S 82°-09'W	159.88
	15	S 81°-38'W	138.50
	16	S 88°-58'W	130.80
	17	S 8°-49'E	81.53
	18	S 65°-00'W	260.00
	19	N 42°-00'W	280.00
	20	S 62°-00'W	420.00

NOTE:

PROPERTY REFERENCE NUMBERS ARE PREFIXED BY "WD"

(dotted)	NEW ENGLAND POWER COMPANY	FEE OWNERSHIP
PROP. NO. 385	NEW ENGLAND POWER COMPANY	FLOWAGE RIGHT FOR DAM, ELEVATION OF WHICH DOES NOT EXCEED 385 U.S.G.S. DATUM
PROP. NO. 390	NEW ENGLAND POWER COMPANY	FLOWAGE RIGHT FOR DAM, ELEVATION OF WHICH DOES NOT EXCEED 390 U.S.G.S. DATUM
PROP. NO. 385 S	NEW ENGLAND POWER COMPANY	FLOWAGE RIGHT; DAM TO BE OPERATED SO THAT ELEVATION OF WATER AT SAID DAM SHALL NOT EXCEED ELEVATION 385 U.S.G.S. DATUM FOR FLOWS OF 140,000 C.F.S. OR LESS

EXHIBIT K-3 (1" = 400') SHEET 2B OF 18

NEW ENGLAND POWER COMPANY

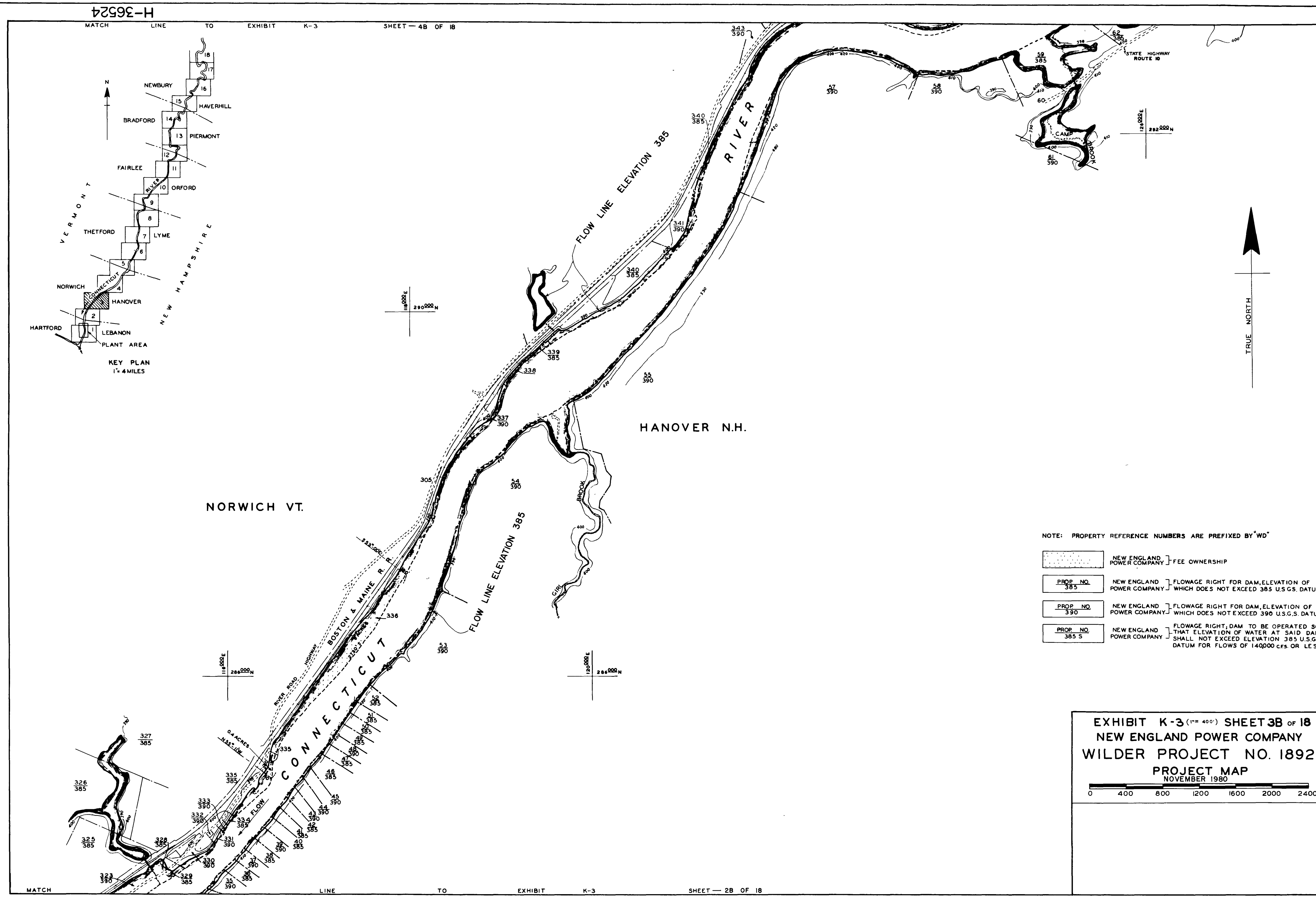
WILDER PROJECT NO. 1892

PROJECT MAP

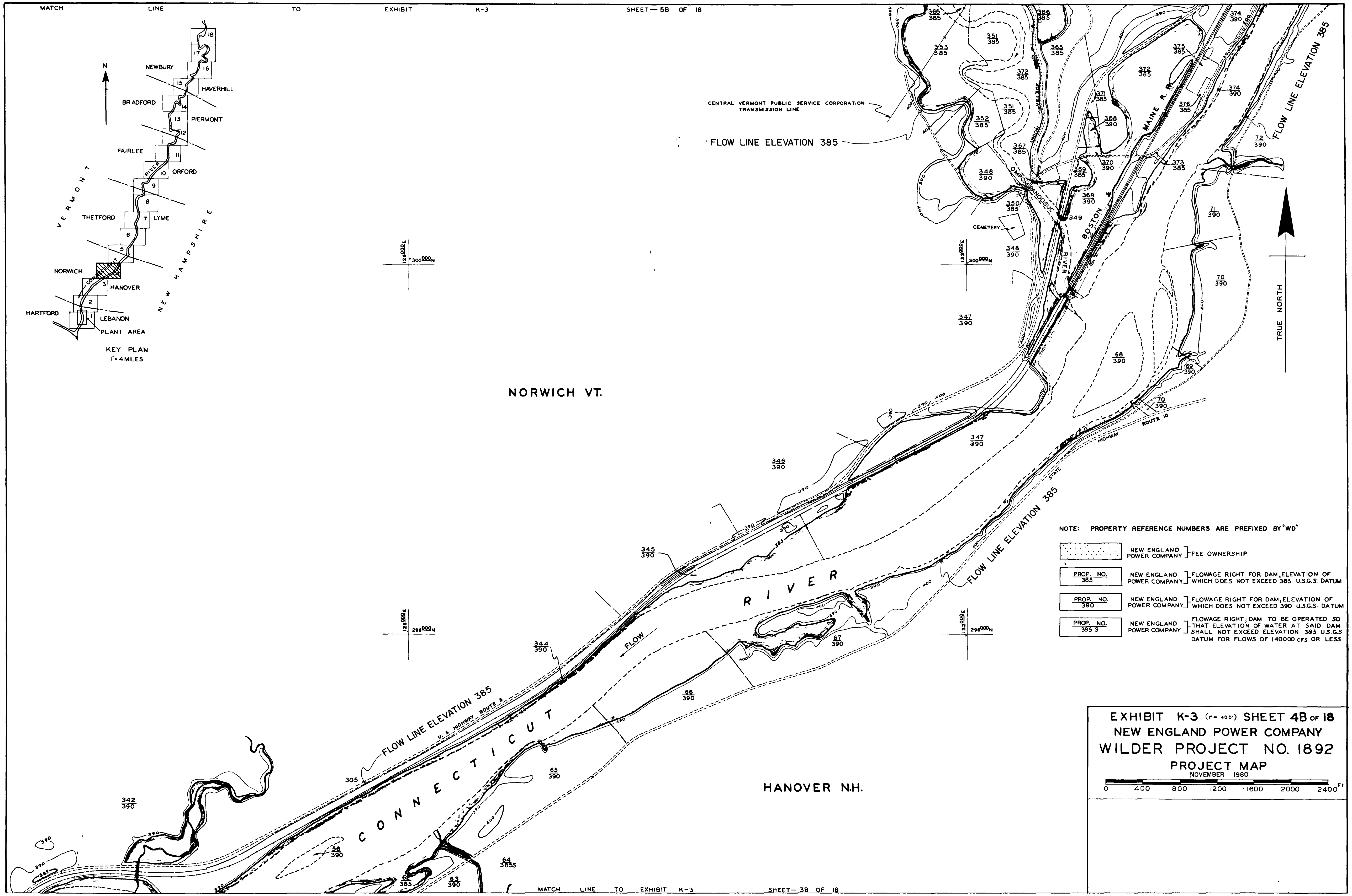
NOVEMBER 1980

0 400 800 1200 1600 2000 2400 Ft.

FERC 1892-III H-36523



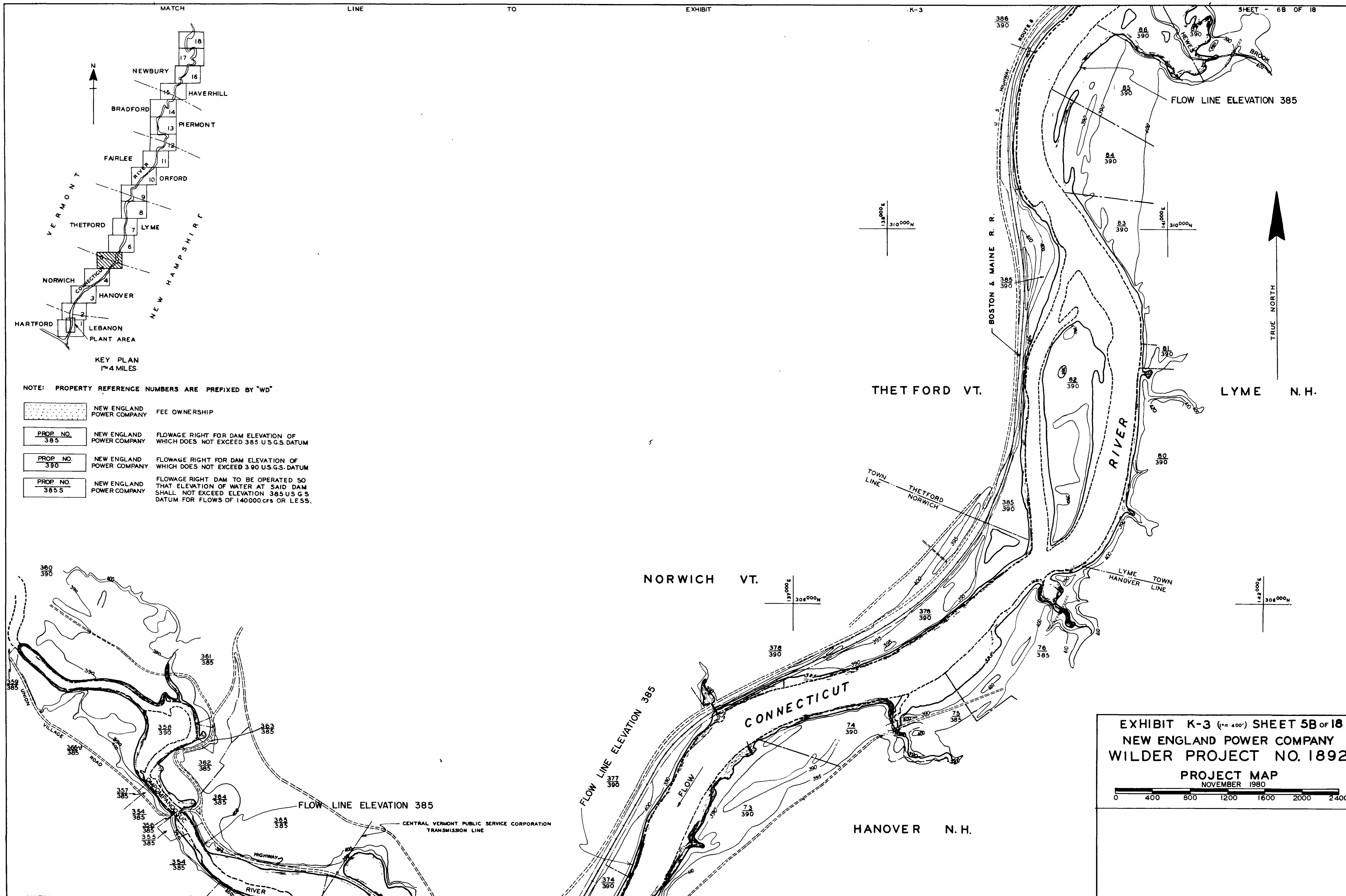
FERC 1892-112 H-36524



FERC 1892-113

H-36525

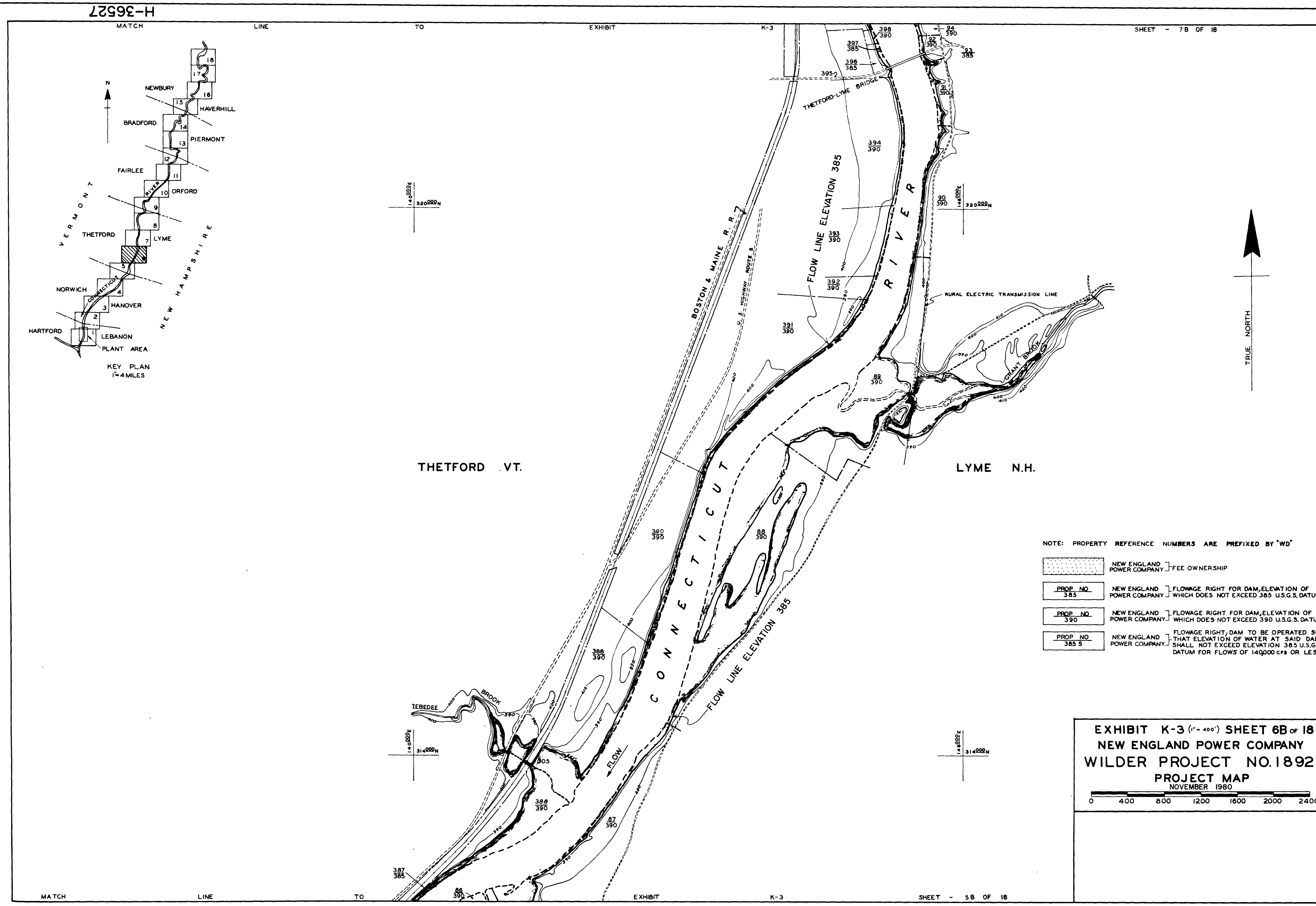
MICROFILM OF THESE ORIGINAL DRAWINGS FILED WITH FERC 11/24/80



MICROFILM OF THESE ORIGINAL DRAWINGS FILED WITH FERC 11/24/80

FERC 1892-114

H-36526

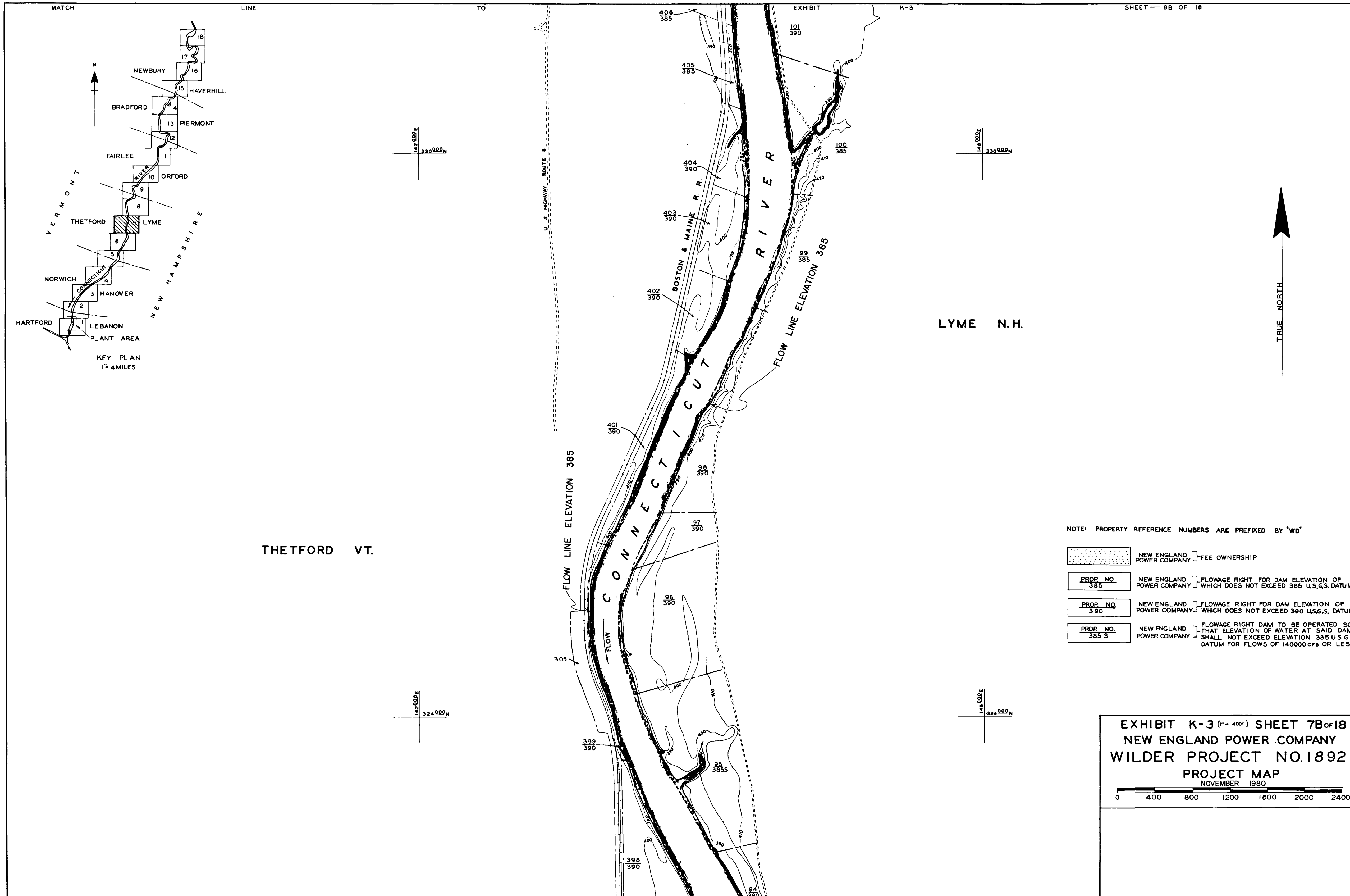


FERC 1892-115

H-36527

MICROFILM OF THESE ORIGINAL DRAWINGS FILED WITH FERC 11/24/80

H-36528



NOTE: PROPERTY REFERENCE NUMBERS ARE PREFIXED BY "WD"

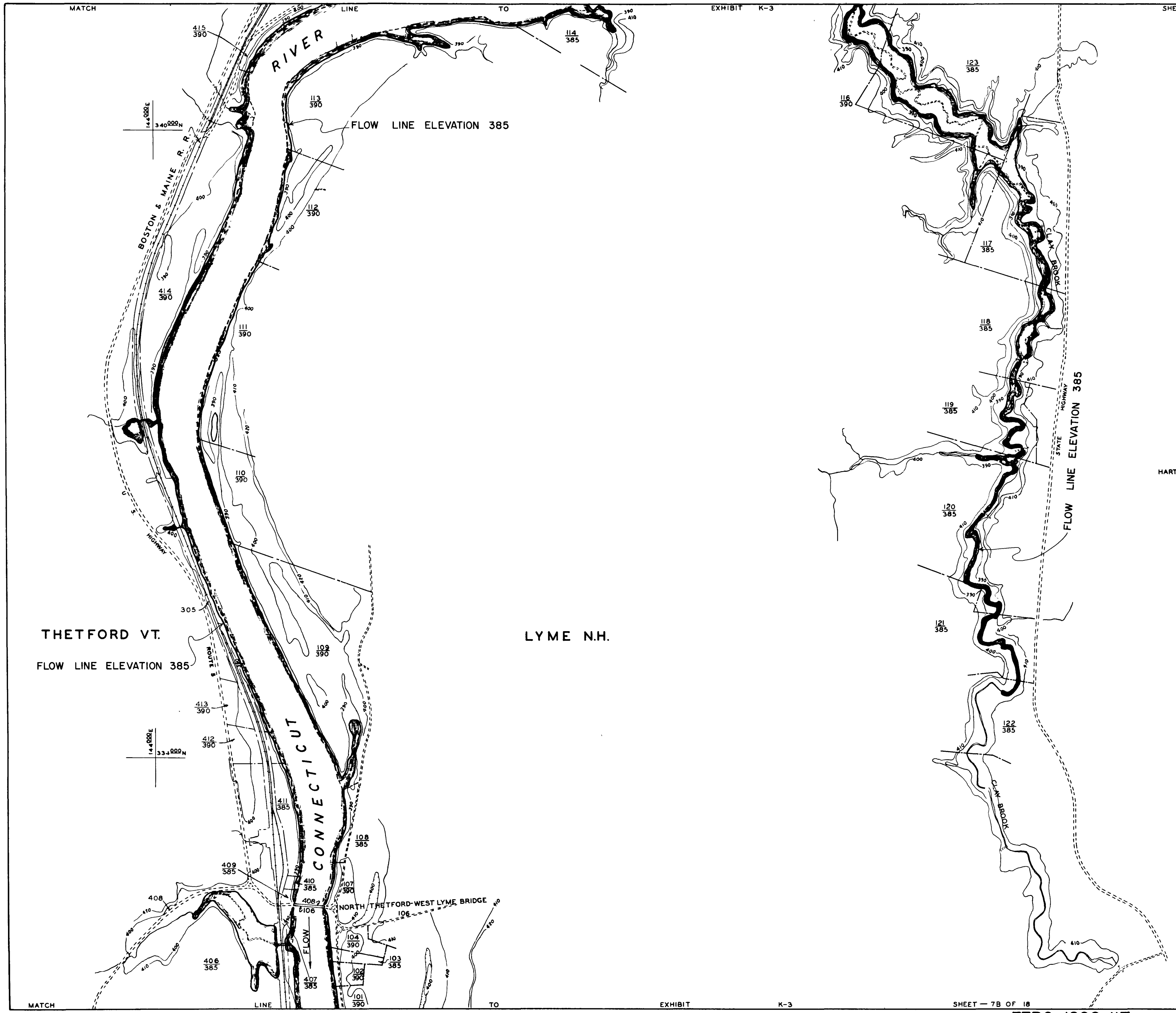
(stippled)	NEW ENGLAND POWER COMPANY — FEE OWNERSHIP
PROP. NO. / 385	NEW ENGLAND POWER COMPANY — FLOWAGE RIGHT FOR DAM ELEVATION OF WHICH DOES NOT EXCEED 385 U.S.G.S. DATUM
PROP. NO. / 390	NEW ENGLAND POWER COMPANY — FLOWAGE RIGHT FOR DAM ELEVATION OF WHICH DOES NOT EXCEED 390 U.S.G.S. DATUM
PROP. NO. / 385 S	NEW ENGLAND POWER COMPANY — FLOWAGE RIGHT DAM TO BE OPERATED SO THAT ELEVATION OF WATER AT SAID DAM SHALL NOT EXCEED ELEVATION 385 U.S.G.S. DATUM FOR FLOWS OF 140000 CFS OR LESS.

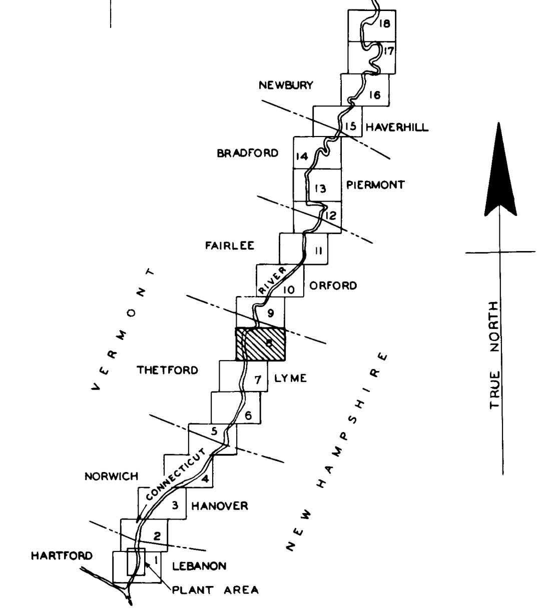
EXHIBIT K-3 (1" = 400') SHEET 7B OF 18
NEW ENGLAND POWER COMPANY
WILDER PROJECT NO. 1892
PROJECT MAP
NOVEMBER 1980
0 400 800 1200 1600 2000 2400 Ft.

FERC 1892-116

H-36528

MATCH LINE TO EXHIBIT K-3 SHEET — 9B OF 18





KEY PLAN
1" = 4 MILES

NOTE: PROPERTY REFERANCE NUMBERS ARE PREFIXED BY "WD"

NEW ENGLAND POWER COMPANY	FEE OWNERSHIP
PROP. NO. 385 — NEW ENGLAND POWER COMPANY	FLOWAGE RIGHT FOR DAM, ELEVATION OF WHICH DOES NOT EXCEED 385 U.S.G.S. DATUM
PROP. NO. 390 — NEW ENGLAND POWER COMPANY	FLOWAGE RIGHT FOR DAM, ELEVATION OF WHICH DOES NOT EXCEED 390 U.S.G.S. DATUM
PROP. NO. 385 S — NEW ENGLAND POWER COMPANY	FLOWAGE RIGHT; DAM TO BE OPERATED SO THAT ELEVATION OF WATER AT SAID DAM SHALL NOT EXCEED ELEVATION 385 U.S.G.S. DATUM FOR FLOWS OF 140,000 C.F.S. OR LESS

EXHIBIT K-3 (1" = 400') SHEET 8B OF 18
NEW ENGLAND POWER COMPANY
WILDER PROJECT NO. 1892
PROJECT MAP
NOVEMBER 1980

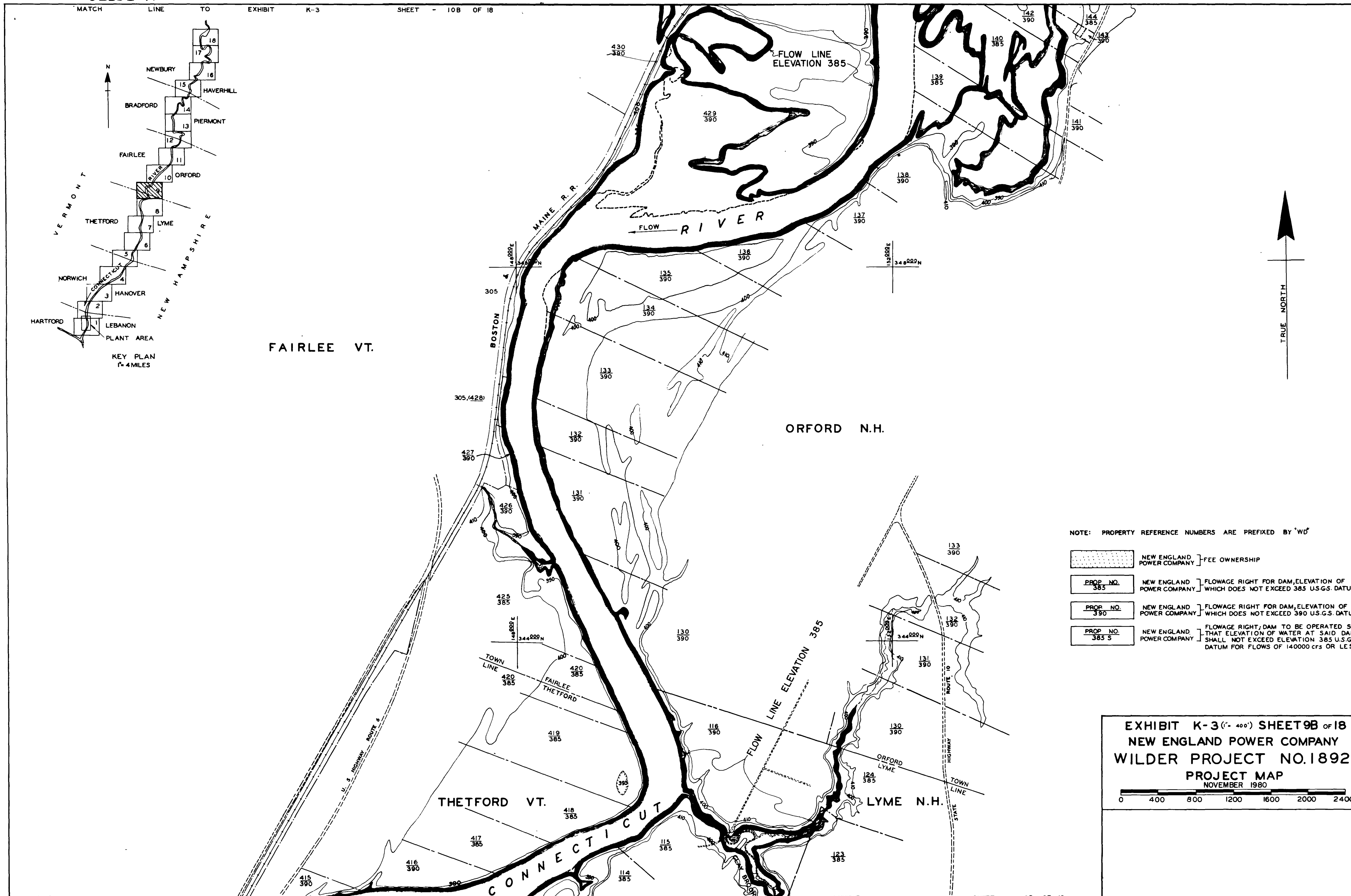
0 400 800 1200 1600 2000 2400 FT.

MATCH LINE TO EXHIBIT K-3 SHEET — 7B OF 18

FERC 1892-117

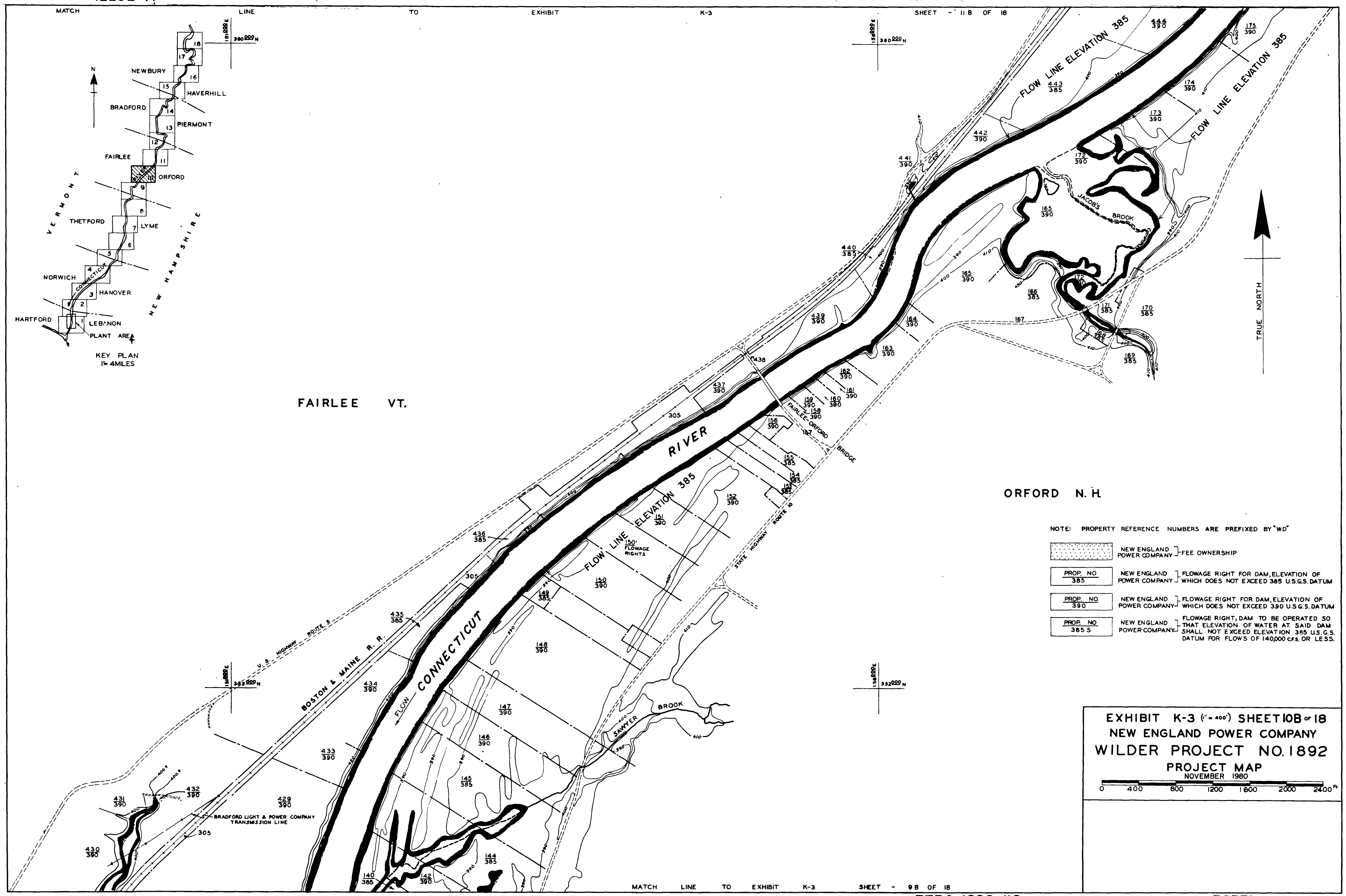
H-36529

MICROFILM OF THESE ORIGINAL DRAWINGS FILED WITH FERC 11/24/80



MICROFILM OF THESE ORIGINAL DRAWINGS FILED WITH FERC 11/24/80

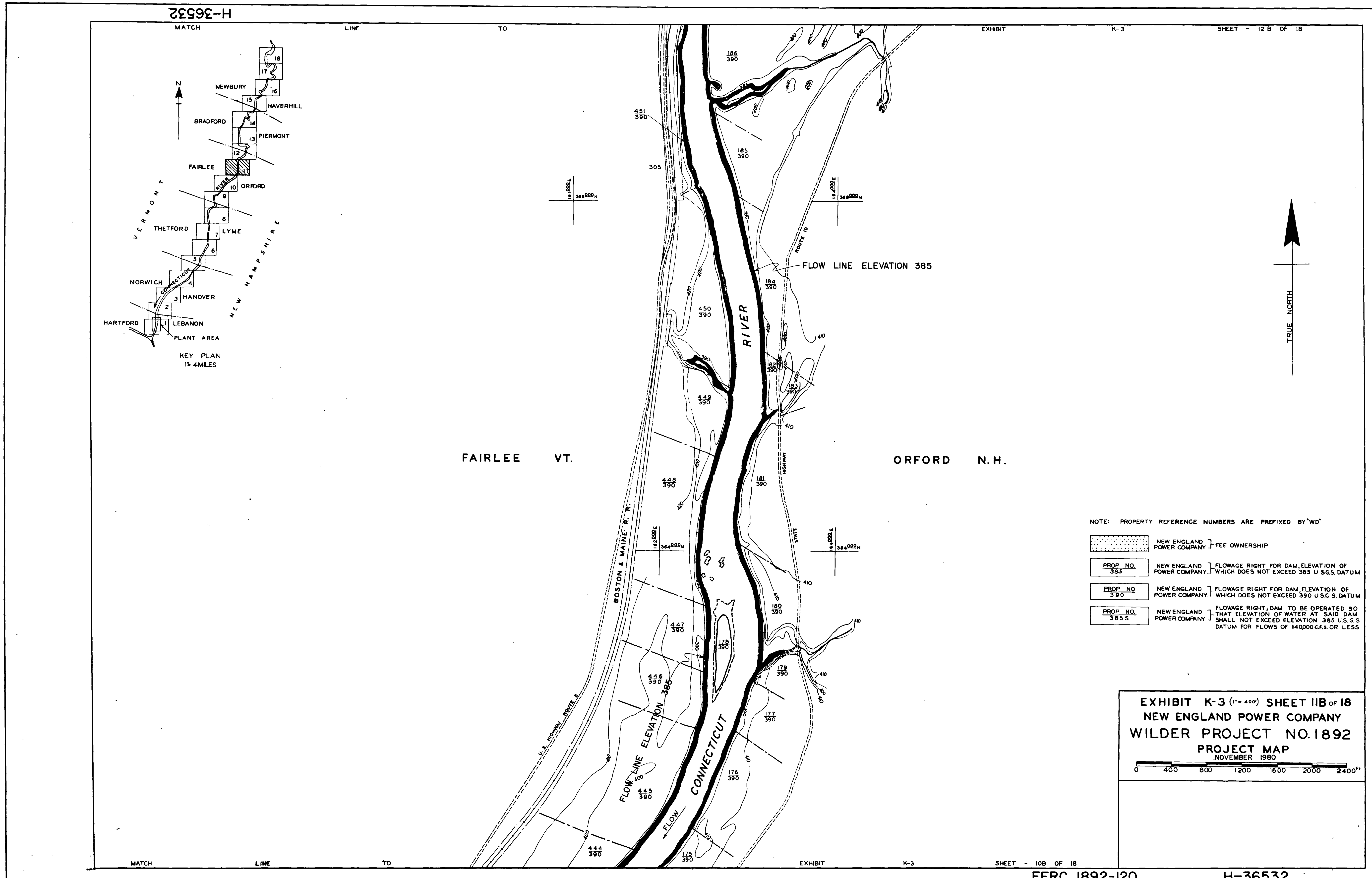
FERC 1892-118 H-36530



FERC 1892-119

H-36531

MICROFILM OF THESE ORIGINAL DRAWINGS FILED WITH FERC 11/24/80



FERC 1892-120 H-36532

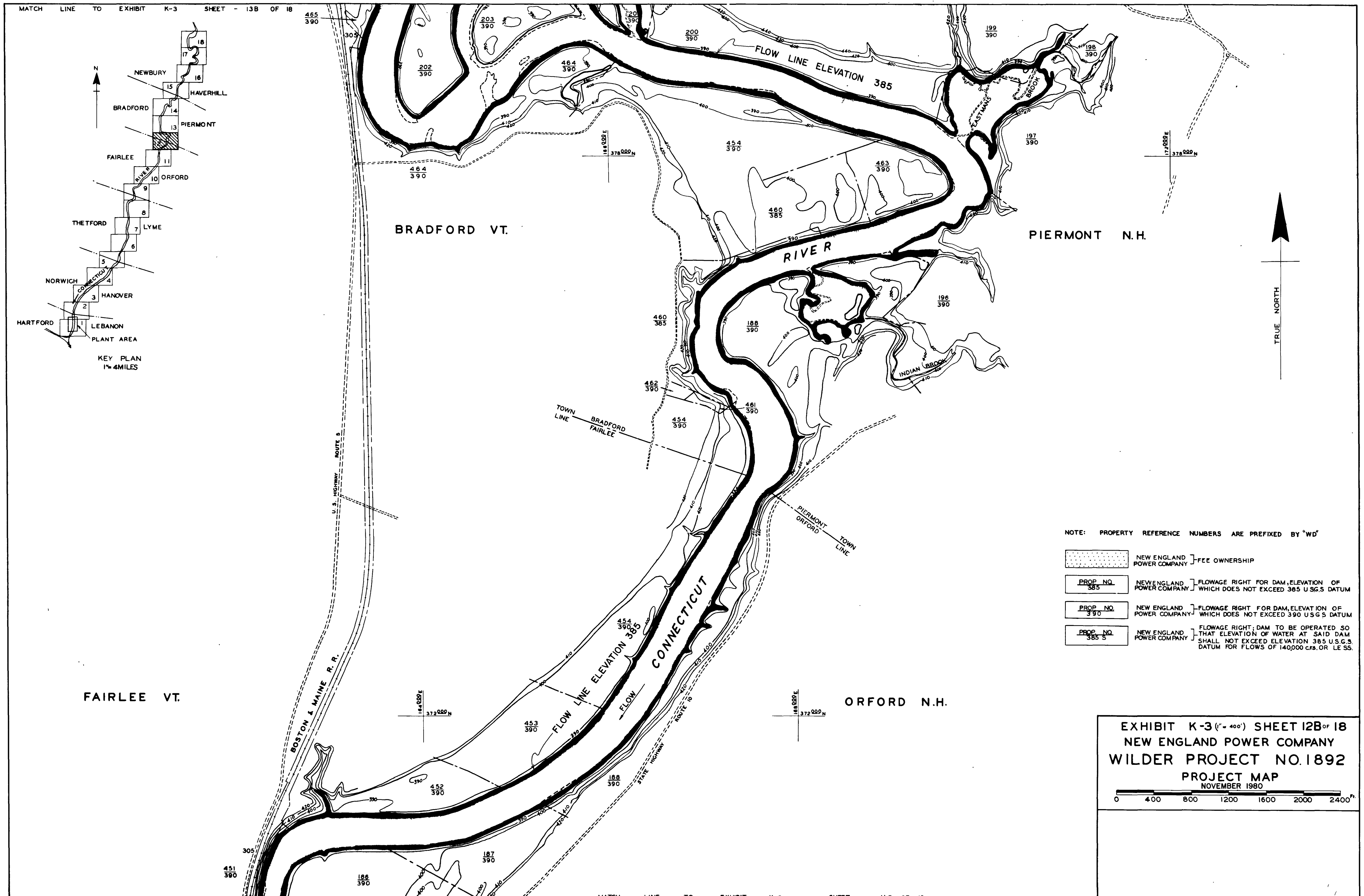


EXHIBIT K-3 (1" = 400') SHEET 12B OF 18

NEW ENGLAND POWER COMPANY

WILDER PROJECT NO. 1892

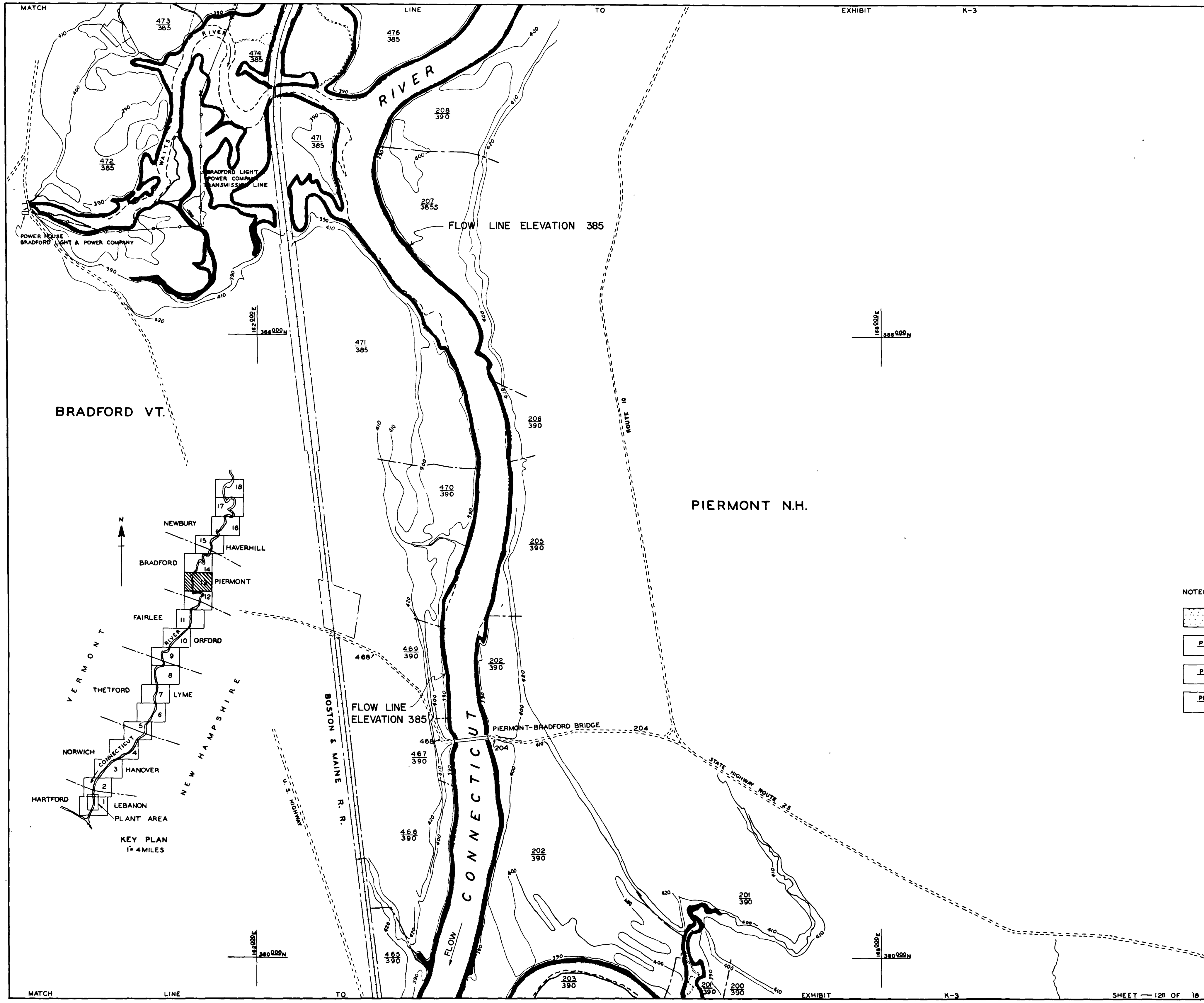
PROJECT MAP

NOVEMBER 1980

0 400 800 1200 1600 2000 2400 FT.

FERC 1892-121

H-36533



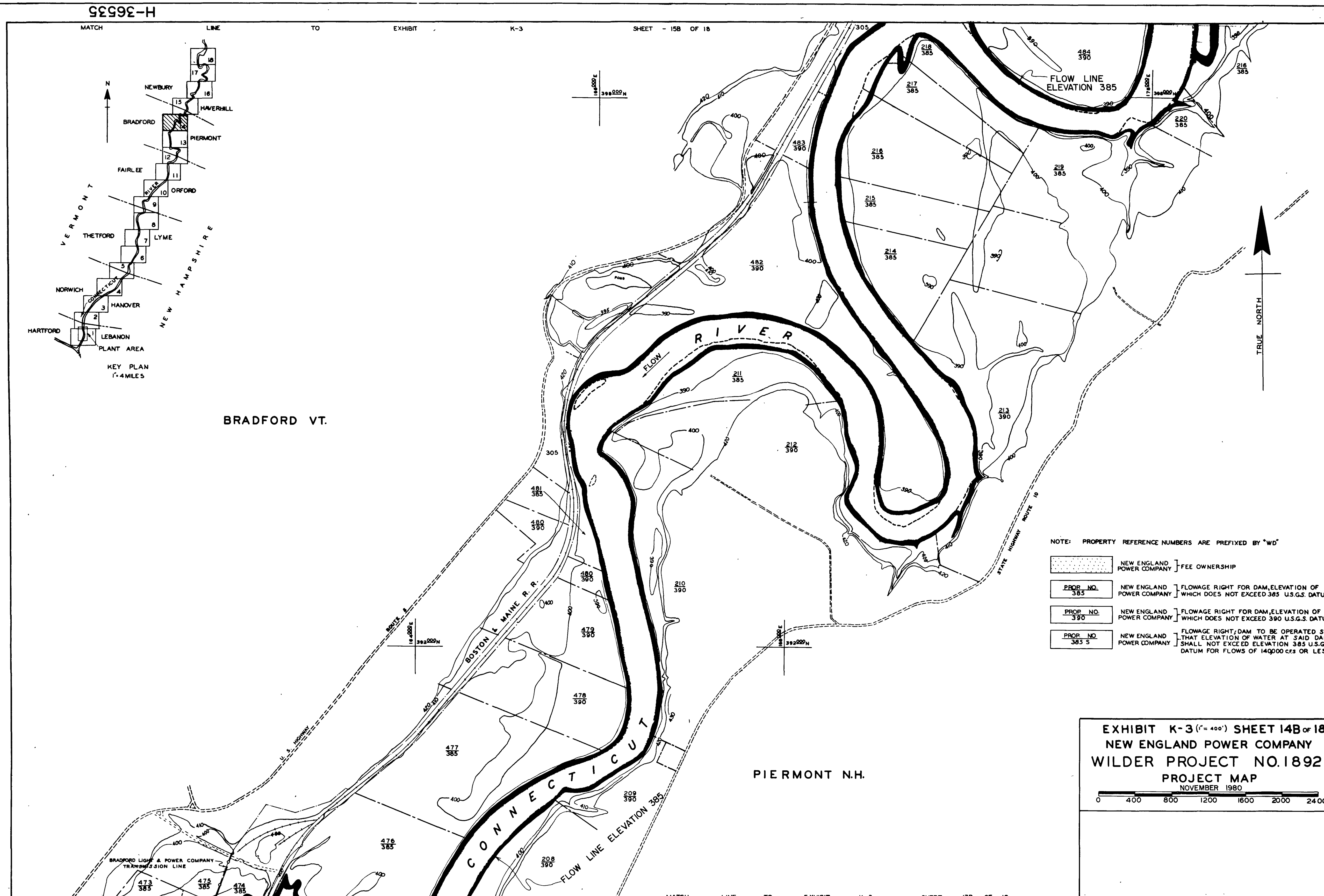
NOTE: PROPERTY REFERENCE NUMBERS ARE PREFIXED BY "WD"

(dotted)	NEW ENGLAND POWER COMPANY	FEE OWNERSHIP
PROP. NO. / 385	NEW ENGLAND POWER COMPANY	FLOWAGE RIGHT FOR DAM, ELEVATION OF WHICH DOES NOT EXCEED 385 U.S.G.S. DATUM
PROP. NO. / 390	NEW ENGLAND POWER COMPANY	FLOWAGE RIGHT FOR DAM, ELEVATION OF WHICH DOES NOT EXCEED 390 U.S.G.S. DATUM
PROP. NO. / 385 S	NEW ENGLAND POWER COMPANY	FLOWAGE RIGHT; DAM TO BE OPERATED SO THAT ELEVATION OF WATER AT SAID DAM SHALL NOT EXCEED ELEVATION 385 U.S.G.S. DATUM FOR FLOWS OF 140,000 C.F.S. OR LESS

EXHIBIT K-3 (1" = 400') SHEET 13B OF 18
NEW ENGLAND POWER COMPANY
WILDER PROJECT NO. 1892
PROJECT MAP
NOVEMBER 1980

0 400 800 1200 1600 2000 2400 Ft.

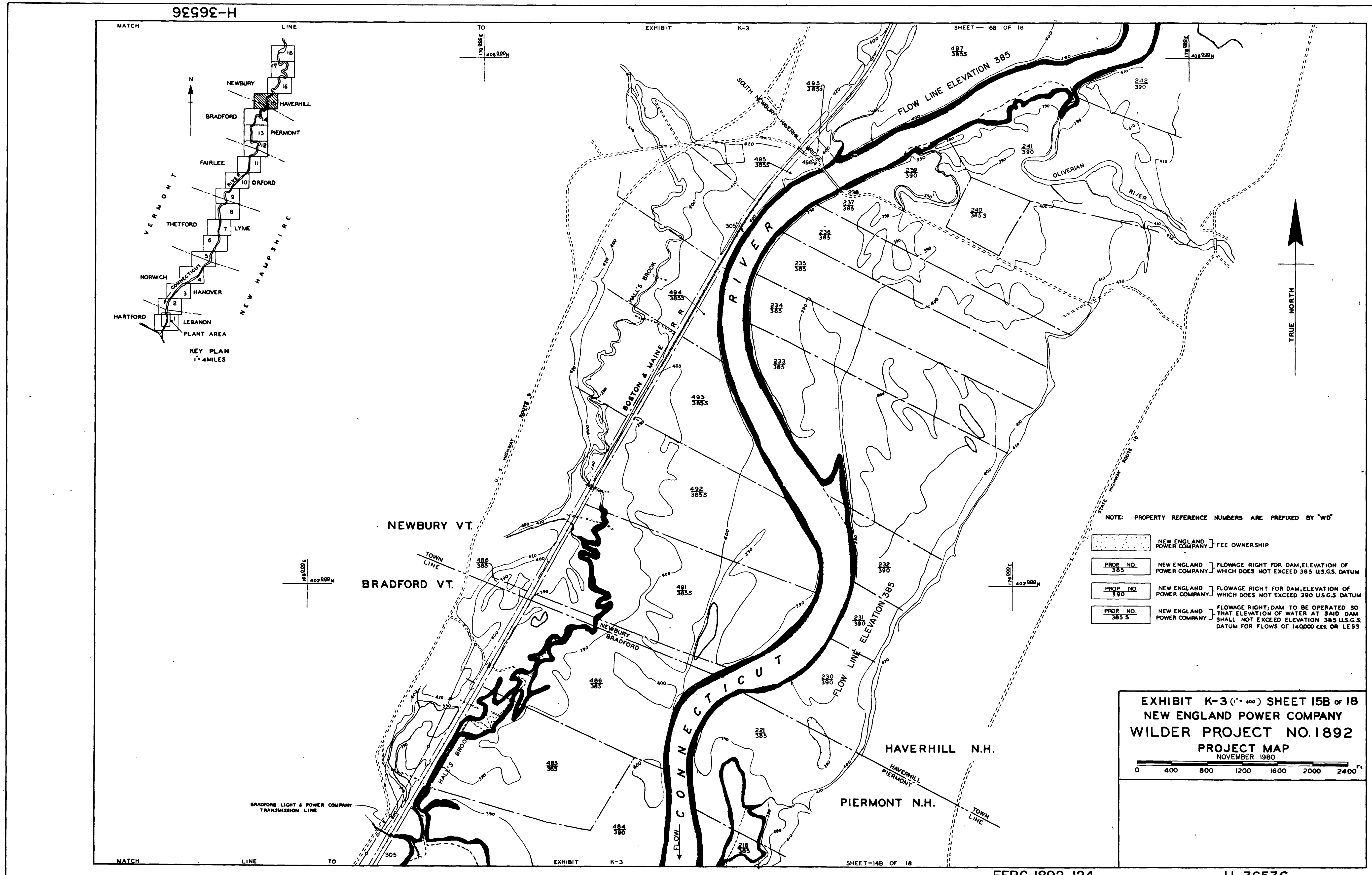
FERC 1892-122 H-36534



FERC 1892-123

H-36535

MICROFILM OF THESE ORIGINAL DRAWINGS FILED WITH FERC 11/24/80


H-36536
MATCH LINE TO EXHIBIT K-3 SHEET—16B OF 18
MATCH LINE TO EXHIBIT K-3 SHEET—14B OF 18
KEY PLAN
1" = 4 MILES
VERMONT
NEW HAMPSHIRE
NEWBURY
HAVERHILL
BRADFORD
PIERMONT
FAIRLEE
ORFORD
THETFORD
LYME
NORWICH
HANOVER
HARTFORD
LEBANON
PLANT AREA
CONNECTICUT RIVER
FLOW LINE ELEVATION 385
SOUTH NEWBURY HAVERHILL BRIDGE
OLIVERIAN RIVER
HALL'S BROOK
BOSTON & MAINE R.R.
U.S. HIGHWAY ROUTE 5
STATE HIGHWAY ROUTE 10
NEWBURY VT.
BRADFORD VT.
TOWN LINE
NEWBURY BRADFORD
HAVERHILL N.H.
PIERMONT N.H.
HAVERHILL PIERMONT
TRUE NORTH
FLOW
BRADFORD LIGHT & POWER COMPANY TRANSMISSION LINE
NOTE: PROPERTY REFERENCE NUMBERS ARE PREFIXED BY "WD"
NEW ENGLAND POWER COMPANY — FEE OWNERSHIP
PROP. NO. 385 — NEW ENGLAND POWER COMPANY — FLOWAGE RIGHT FOR DAM, ELEVATION OF WHICH DOES NOT EXCEED 385 U.S.G.S. DATUM
PROP. NO. 390 — NEW ENGLAND POWER COMPANY — FLOWAGE RIGHT FOR DAM, ELEVATION OF WHICH DOES NOT EXCEED 390 U.S.G.S. DATUM
PROP. NO. 385 S — NEW ENGLAND POWER COMPANY — FLOWAGE RIGHT; DAM TO BE OPERATED SO THAT ELEVATION OF WATER AT SAID DAM SHALL NOT EXCEED ELEVATION 385 U.S.G.S. DATUM FOR FLOWS OF 140,000 C.F.S. OR LESS
EXHIBIT K-3 (1" = 400') SHEET 15B OF 18
NEW ENGLAND POWER COMPANY
WILDER PROJECT NO. 1892
PROJECT MAP
NOVEMBER 1980
0 400 800 1200 1600 2000 2400 Ft.
FERC 1892-124
H-36536

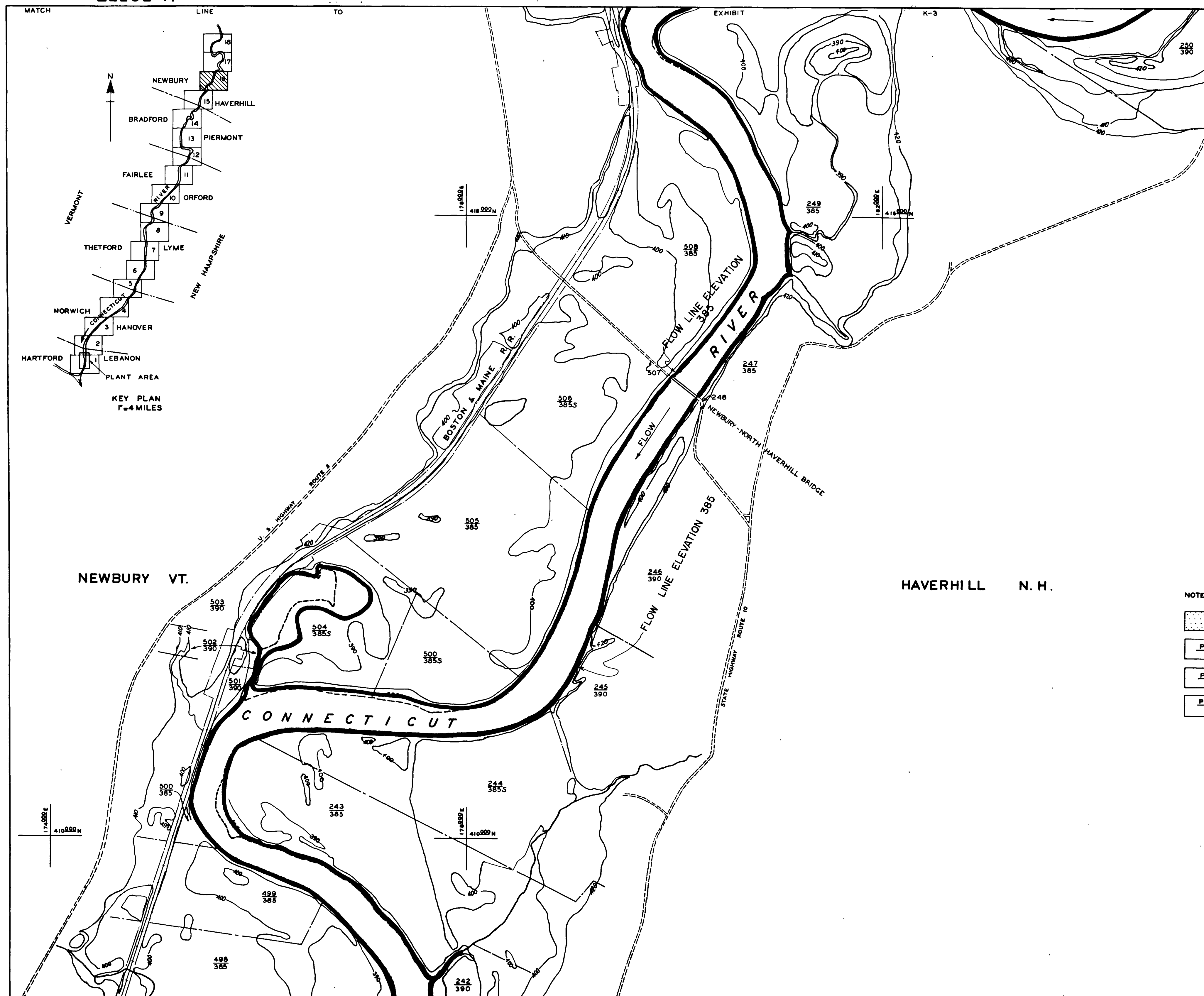


EXHIBIT K-3 (1"= 400') SHEET 16B OF 18
NEW ENGLAND POWER COMPANY
WILDER PROJECT NO. 1892
PROJECT MAP
NOVEMBER 1980

FERC 1892-125 H-36537

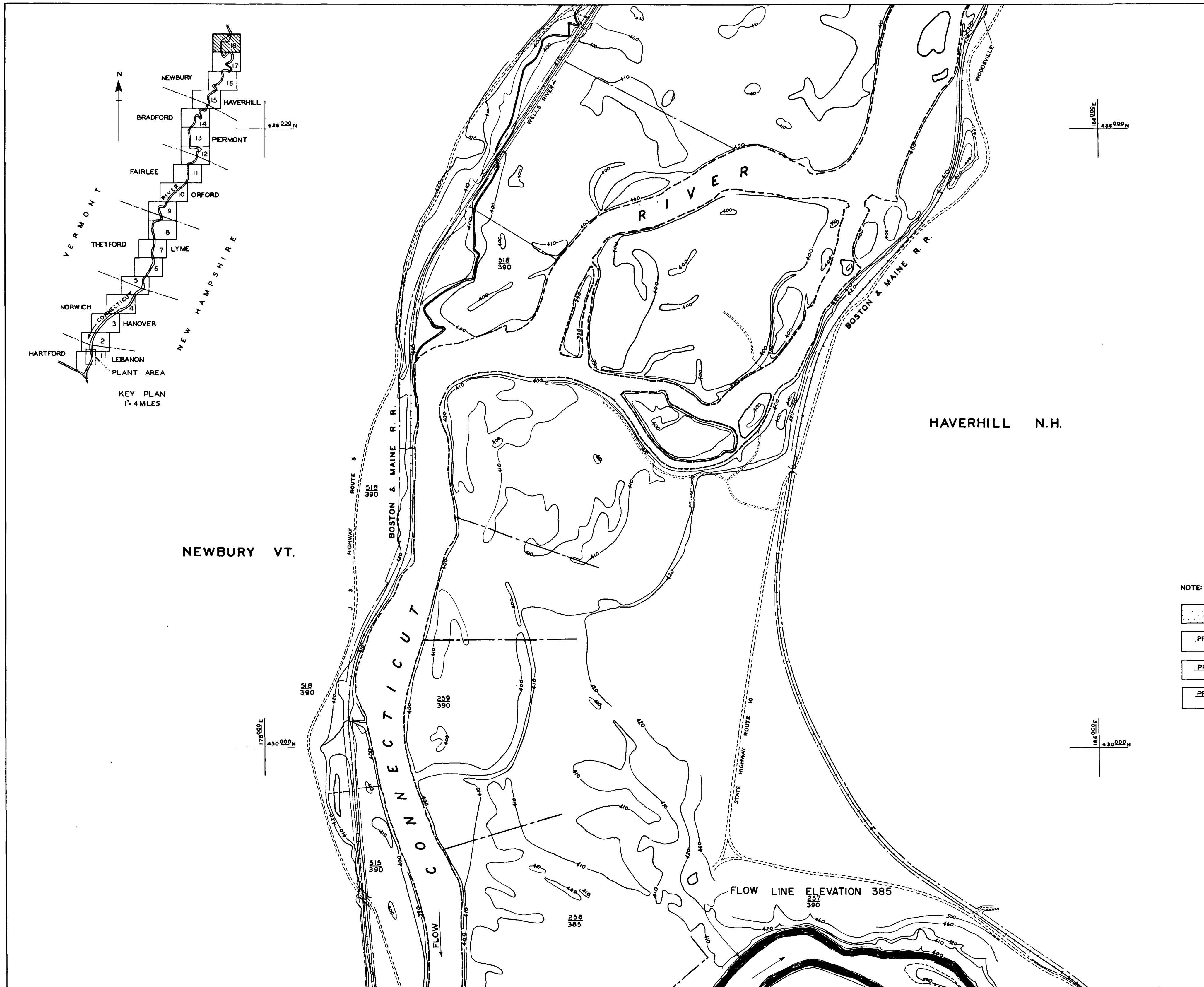
MICROFILM OF THESE ORIGINAL DRAWINGS FILED WITH FERC 11/24/80

NOTE: PROPERTY REFERENCE NUMBERS ARE PREFIXED BY "WD"

(dotted)	NEW ENGLAND POWER COMPANY	FEE OWNERSHIP
PROP. NO. / 385	NEW ENGLAND POWER COMPANY	FLOWAGE RIGHT FOR DAM, ELEVATION OF WHICH DOES NOT EXCEED 385 U.S.G.S. DATUM
PROP. NO. / 390	NEW ENGLAND POWER COMPANY	FLOWAGE RIGHT FOR DAM, ELEVATION OF WHICH DOES NOT EXCEED 390 U.S.G.S. DATUM
PROP. NO. / 385 S	NEW ENGLAND POWER COMPANY	FLOWAGE RIGHT; DAM TO BE OPERATED SO THAT ELEVATION OF WATER AT SAID DAM SHALL NOT EXCEED ELEVATION 385 U.S.G.S. DATUM FOR FLOWS OF 140,000 C.F.S. OR LESS

EXHIBIT K-3 (1" = 400') SHEET 17B of 18
NEW ENGLAND POWER COMPANY
WILDER PROJECT NO. 1892
PROJECT MAP
NOVEMBER 1980

0 400 800 1200 1600 2000 2400 Ft.



NOTE: PROPERTY REFERENCE NUMBERS ARE PREFIXED BY "WD"

(dotted)	NEW ENGLAND POWER COMPANY	FEE OWNERSHIP
PROP. NO. 385	NEW ENGLAND POWER COMPANY	FLOWAGE RIGHT FOR DAM, ELEVATION OF WHICH DOES NOT EXCEED 385 U.S.G.S DATUM
PROP. NO. 390	NEW ENGLAND POWER COMPANY	FLOWAGE RIGHT FOR DAM, ELEVATION OF WHICH DOES NOT EXCEED 390 U.S.G.S. DATUM
PROP. NO. 385 S	NEW ENGLAND POWER COMPANY	FLOWAGE RIGHT DAM TO BE OPERATED SO THAT ELEVATION OF WATER AT SAID DAM SHALL NOT EXCEED ELEVATION 385 U.S.G.S. DATUM FOR FLOWS OF 140,000 CFS OR LESS

EXHIBIT K-3 (1" = 400') SHEET 18B OF 18
NEW ENGLAND POWER COMPANY
WILDER PROJECT NO. 1892
PROJECT MAP
NOVEMBER 1980

0 400 800 1200 1600 2000 2400 Ft

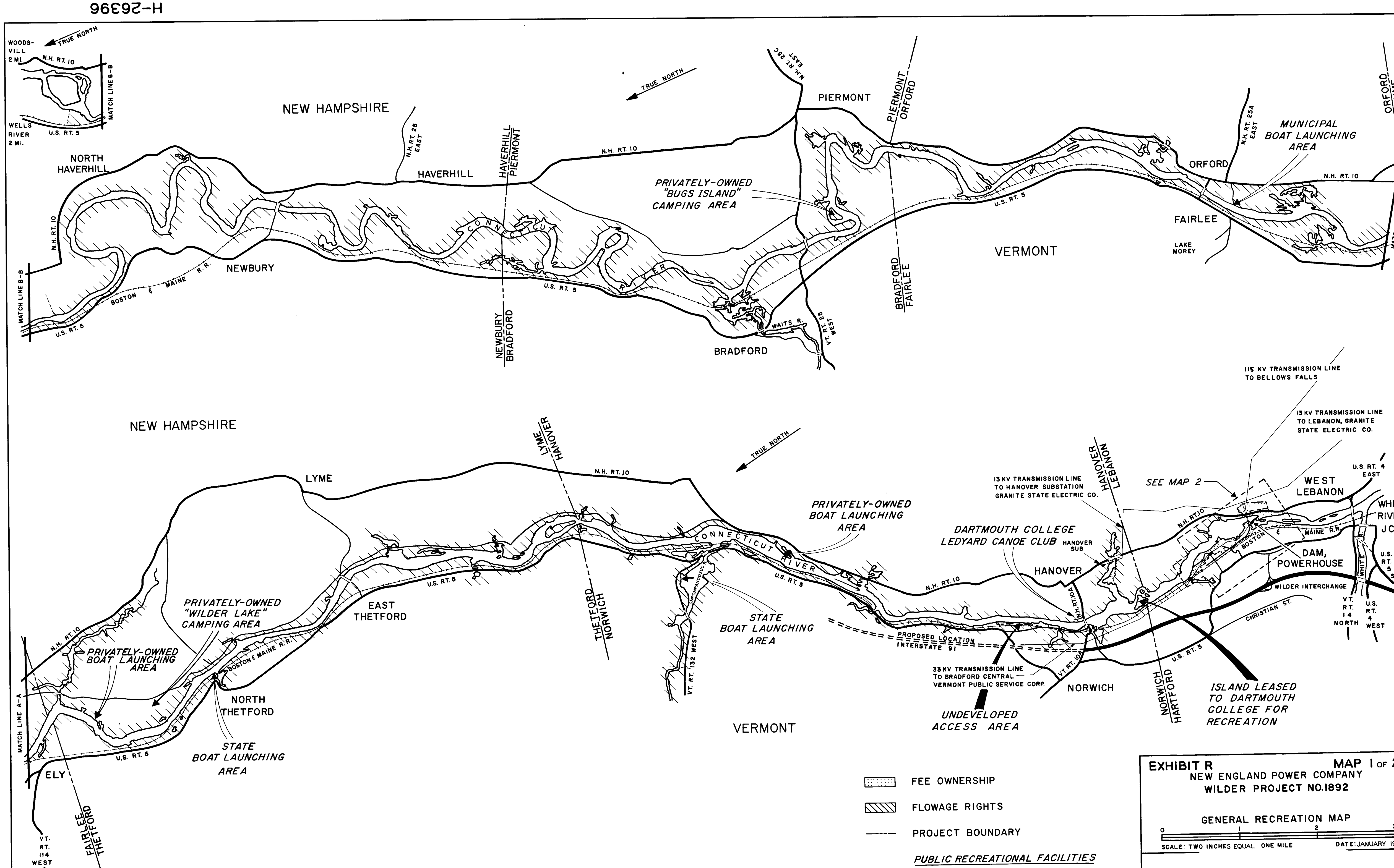
FERC 1892-127

H-36539

MICROFILM OF THESE ORIGINAL DRAWINGS FILED WITH FERC 11/24/80

ATTACHMENT 2

PROJECT RECREATION MAPS



FEE OWNERSHIP

FLOWAGE RIGHTS

PROJECT BOUNDARY

PUBLIC RECREATIONAL FACILITIES

—NEW ENGLAND POWER CO.

—OTHER

EXHIBIT R MAP 1 OF 2

NEW ENGLAND POWER COMPANY
WILDER PROJECT NO.1892

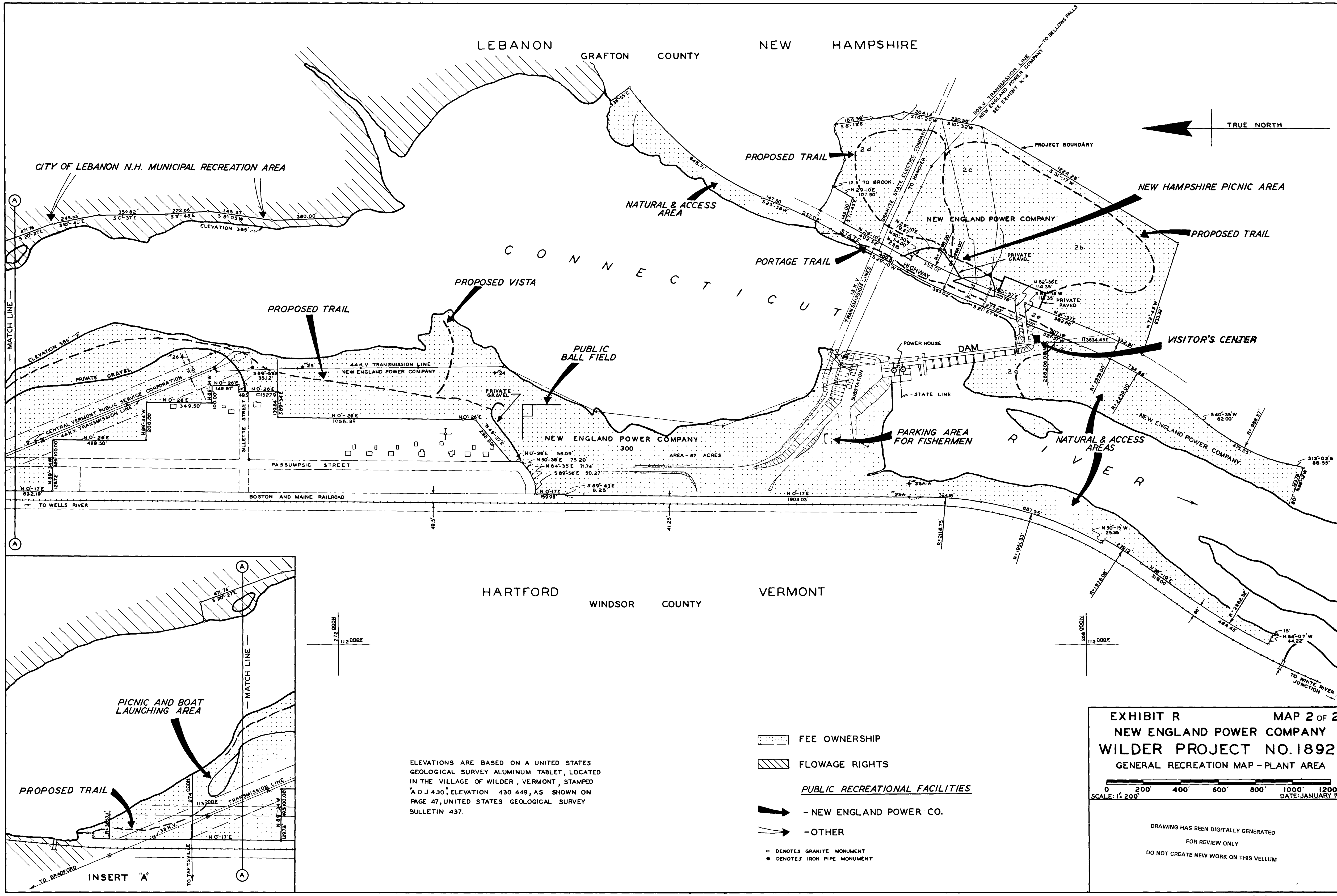
GENERAL RECREATION MAP

0 1 2 3 MI.

SCALE: TWO INCHES EQUAL ONE MILE DATE: JANUARY 1969

DRAWING HAS BEEN DIGITALLY GENERATED
FOR REVIEW ONLY
DO NOT CREATE NEW WORK ON THIS VELLUM

H-26396



LEBANON
GRAFTON COUNTY
NEW HAMPSHIRE
TRUE NORTH
CITY OF LEBANON N.H. MUNICIPAL RECREATION AREA
NATURAL & ACCESS AREA
PROPOSED TRAIL
PORTAGE TRAIL
NEW HAMPSHIRE PICNIC AREA
NEW ENGLAND POWER COMPANY
PROJECT BOUNDARY
CONNECTICUT RIVER
PROPOSED VISTA
PUBLIC BALL FIELD
VISITOR'S CENTER
DAM
POWER HOUSE
STATE LINE
SUBSTATION
PARKING AREA FOR FISHERMEN
NATURAL & ACCESS AREAS
44 K.V. TRANSMISSION LINE
CENTRAL VERMONT PUBLIC SERVICE CORPORATION
GILLETTE STREET
PASSUMPSIC STREET
BOSTON AND MAINE RAILROAD
TO WELLS RIVER
TO WHITE RIVER JUNCTION
AREA - 87 ACRES
MATCH LINE
HARTFORD
WINDSOR COUNTY
VERMONT
PICNIC AND BOAT LAUNCHING AREA
PROPOSED TRAIL
TO BRADFORD
TO TAFTSVILLE
INSERT "A"
ELEVATIONS ARE BASED ON A UNITED STATES GEOLOGICAL SURVEY ALUMINUM TABLET, LOCATED IN THE VILLAGE OF WILDER, VERMONT, STAMPED "A D J 430", ELEVATION 430.449, AS SHOWN ON PAGE 47, UNITED STATES GEOLOGICAL SURVEY BULLETIN 437.
FEE OWNERSHIP
FLOWAGE RIGHTS
PUBLIC RECREATIONAL FACILITIES
- NEW ENGLAND POWER CO.
- OTHER
○ DENOTES GRANITE MONUMENT
● DENOTES IRON PIPE MONUMENT
EXHIBIT R
MAP 2 OF 2
NEW ENGLAND POWER COMPANY
WILDER PROJECT NO. 1892
GENERAL RECREATION MAP - PLANT AREA
0 200' 400' 600' 800' 1000' 1200'
SCALE: 1" = 200'
DATE: JANUARY 1969
DRAWING HAS BEEN DIGITALLY GENERATED
FOR REVIEW ONLY
DO NOT CREATE NEW WORK ON THIS VELLUM

H-26397